Marshall Labs

CIMRON
DIVISION

SERIES 7600
DIGITAL MULTIMETER
INSTRUCTION MANUAL

LEAR SIEGLER, INC.

CIMRON

SERIES 7600
DIGITAL MULTIMETER
INSTRUCTION MANUAL

CIMRON DIVISION of LEAR SIEGLER, INC.
1152 Morena Blvd, San Diego, California 92110

Area Code 714 - Phone 276-3200 - TWX 910-335-1196

SECTION I

INTRODUCTION

This manual contains operation, calibration, and maintenance instructions for the Cimron Series 7600 Digital Multimeter and, when applicable, for various plug-in accessories. Section I contains a general description of the instruments and their capabilities. Section II specifies the electrical and physical characteristics of the Series 7600 Digital Multimeter, Model 6770 AC Converter, Model 6880 DC Preamplifier, and Model 6990 Ohms Converter Plug-In Accessories. Section III provides an initial-receipt inspection procedure of the instrument, explains the purpose of front panel controls, and describes the instrument operational checkout. Section IV contains operational adjustments and calibration and specification validation procedures for the Series 7600 Digital Multimeter. Section V provides a general description of the theory of operation of the Digital Multimeter, a circuit description of each assembly comprising the Digital Multimeter, and an explanation of the Digital Multimeter logic. Section VI contains general maintenance and troubleshooting information together with illustrated component locations, schematic diagrams, and parts lists for each Digital Multimeter assembly. Section VII lists recommended spare assemblies and spare parts required to maintain a specified number of instruments in an isolated area for a period of one year. Section VIII contains operational adjustments and calibration and specification validation procedures, theory of operation, and maintenance information for plug-in accessories used with the Digital Multimeter. An appendix contains a list of abbreviations, list of manufacturers, and the warranty.

The multimeter measures DC voltages from 0.0000 to ±999.99 volts and indicates the voltage, range, and polarity on the front panel indicators. The input is floating to allow bipolar operation and high common mode rejection. The polarity of a DC input voltage is automatically indicated. The range is selected either manually or automatically. When DC auto-ranging is selected, the multimeter tracks the input signal, continuously indicating the voltage present at the input. Small changes that occur in the input are followed digit for digit. When

the input signal changes a large amount, the multimeter changes to a logic which more rapidly spans large increments of voltage. The rapid logic method is used until the multimeter approaches null, when the digit-for-digit mode of operation is resumed.

The digital multimeters incorporate a voltage ratio measurement capability. When this mode of operation is selected by the operating controls, the instrument indicates the ratio of the input signal to an external reference voltage. The multimeter automatically selects the polarity of the external reference which may be any voltage from ±1.0000 volt to ±100.00 volts DC.

There are two 5-digit models of the Series 7600 Digital Multimeter, Model 7650 and Model 7630. The Model 7650 has a printout capability not contained in the Model 7630. Connectors on the rear panel of the Model 7650 provide isolated contact closures for a printout of the digital multimeter indication. The 10-line parallel decimal output is suitable for operation of a digital printer or other recording device. Various BCD code outputs are available on special order.

Certain plug-in accessories are available for use with the Series 7600 Digital Multimeter. The accessories include the Model 6770 AC Converter, the Model 6880 DC Preamplifier, the Model 6990 Ohms Converter, and the Model 985 Accessory Power Supply. The Model 985 Accessory Power Supply must be inserted in the multimeter for operation of any of the other three accessories. These plug-in accessories allow AC voltage measurements from 10 microvolts AC to 999.99 volts AC, millivolt measurements from 0 to 999.99 millivolts, and resistance measurements from 10 milliohms to 9.9999 megohms. Operation, calibration, and maintenance instructions are contained in Section VIII for each plug-in accessory shipped with the multimeter. When any of the plug-in accessories not shipped with the multimeter are acquired at a later date, up-to-date instructions are furnished with the plug-in accessory.

Solid state components are used exclusively, with the exception of the critical circuitry associated with the digital potentiometer. This potentiometer circuit employs low-thermal switches as precision switching elements.

The low heat dissipation of the instrument permits a tightly closed cabinet which reduces dust and humidity considerations.

SECTION II

SPECIFICATIONS

MULTIMETER WITHOUT PLUG-IN ACCESSORIES

INPUT CIRCUIT	The input signal leads are floating and isolated from case, power line ground and printer output. A guard shield is employed to guarantee maximum input isolation and common mode rejection.
COMMON MODE REJECTION	1,000,000:1 (120 dB) at DC and 100,000:1 (100 dB) at 60 Hz. Input may be floated up to 1000V DC or peak AC.
VOLTAGE RANGE	0.0000 to ±999.99V DC in three ranges of ±9.9999, ±99.999, and ±999.99V DC.
RANGE AND POLARITY SELECTION	Automatic plus manual front panel range control.
DISPLAY	Full five digits using long life readout tubes mounted behind non-reflecting polarizing screen.
ACCURACY	Within 0.001% of full scale +0.01% of reading for at least 90 days after calibration.
RESOLUTION	100 microvolts.
INPUT RESISTANCE	In excess of 10,000 megohms at balance on 9.9999V DC range (instrument will measure voltage from a 10 megohm source); 11 megohms independent of balance on 99.999 and 999.99V DC ranges.

RESPONSE TIME	Without filter, maximum balancing time with range or polarity changes is 0.9 second. Maximum balancing time without range or polarity change is 0.6 second. Minimum balancing time is under 7 milliseconds; clock rate is approximately 200 per second. With filter, balancing times are increased by a factor of 2 to 3.
OPERATING TEMPERATURE RANGE	0° to +50°C; no lengthy warm-up required; specified accuracy is obtained within thirty minutes.
DIGITAL OUTPUT (Model 7650)	The complete digital reading including range and polarity is available on rear mounted connectors. Output information is provided by isolated contacts of reed relays in ten line decimal code. BCD output models are also available. Contact ratings are 250V or .5A with a 10 volt-amps maximum.
POWER REQUIREMENTS	105 to 125/210 to 250 volts, 50 to 400 Hz, approximately 35 volts-amps.
WEIGHT	36 lbs. net; 40 lbs. shipping.
SIZE	5-1/4" high x 19" wide x 18.3" deep. Suitable for standard 19" rack mounting.

RATIO OPERATION OF THE MULTIMETER

RANGE	.00000:1 to 99.999:1 in three manual ranges of .99999:1, 9.9999:1 and 99.999:1.
ACCURACY	Within 0.002% of full scale +0.005% of reading.

EXTERNAL REFERENCE RANGE	Less than ±1 volt, DC, to ±100 volts, DC.
INPUT RESISTANCE FOR EXTERNAL REFERENCE	100,000 ohms.
POLARITY	Automatic bipolar.
RESOLUTION (digits)	10/(ref. voltage) or 0.005% of reading or 1 digit, whichever is greater.

MULTIMETER WITH AC CONVERTER PLUG-IN ACCESSORY

RANGES	0.0000 to 999.99V AC in three manually selected ranges of 9.9999, 99.999 and 999.99V AC.
ACCURACY	Within 0.1% of reading or 0.02% of full scale from 30 Hz to 10 KHz.
LINEARITY	Within 0.02% of full scale from 30 Hz to 10 KHz.
INPUT IMPEDANCE	1 megohm shunted by 50 pf.
FLOATING INPUT	Input to the connector is floated from case ground, power line ground or print output of the digital multimeter.

MULTIMETER WITH DC PREAMPLIFIER PLUG-IN ACCESSORY

RANGES	10 - ±0.0001 to ±9.9999 millivolts full scale. 100 - ±00.001 to ±99.999 millivolts full scale. 1K - ±000.01 to ±999.99 millivolts full scale.

ACCURACY

1K and 100 range: 0.02% of reading or ±1 digit or ±2 microvolts, whichever is greater.

10 range: 0.03% of reading or ±2 microvolts, whichever is greater.

GAIN STABILITY

0.01% for at least 30 days.

LINEARITY

0.001% of full scale.

DRIFT

After 30 minutes warmup and under constant temperature conditions, drift will be less than ±5 microvolts or ±1 digit, whichever is greater, for a period of at least 7 days.

COMMON MODE REJECTION

Gain Range	DC	60 Hz
10	150 dB	140 dB
100	140 dB	130 dB
1K	130 dB	120 dB

INPUT RESISTANCE

10 range: greater than 10 megohms.
100 range: greater than 100 megohms.
1K range: greater than 1000 megohms.

MULTIMETER WITH OHMS CONVERTER PLUG-IN ACCESSORY

RANGES

0 to 9.9999 megohms in five manually selectable ranges of 999.99 ohms, 9.9999K ohms, 99.999K ohms, 999.99K ohms and 9.9999 megohms.

ACCURACY

1000 ohms, 10,000 ohms and 100,000 ohms ranges: ±0.002% of full scale or 0.01% of reading.

ACCURACY (Cont'd)	1 megohm range: ±0.002% of full scale or ±0.02% of reading. 10 megohm range: ±0.005% of full scale or ±0.05% of reading.
STABILITY	0.01% of full scale for at least 90 days on all ranges except the 10 megohm range which is 0.05% of full scale.
CONSTANT CURRENT RANGES	10 mA, 1 mA, 100, 10 and 1 microampere.
CURRENT REGULATION	Output current will vary less than 0.01% for any output voltage from 0 to 10.0 volts.
SENSING	Two-wire sensing on all ranges, but includes zero control to compensate for a fixed lead resistance of up to 2 ohms.

SECTION III

PRELIMINARY INSPECTION AND OPERATION

INSPECTION UPON RECEIPT

The instrument is aligned, calibrated, and tested under severe environmental conditions prior to shipment. It is ready for immediate use upon receipt. Make the following checks, however, to assure that the instrument has suffered no damage in shipment:

1. Visually inspect the shipping container prior to acceptance from the carrier. Note any damage to the shipping container on the carrier's receipt for the carrier's agent to sign.

2. Visually inspect for damage upon removing the instrument from the shipping container.

3. Determine that the circuit boards are mated with their connectors and are well seated. Inspect for broken or damaged components.

4. If damage is not apparent until the instrument is accepted, file a claim for concealed damage with the carrier within 15 days of receipt. All packaging materials must be maintained for inspection. A copy of the claim must be sent to Cimron Division/Lear Siegler Inc.

OPERATING CONTROLS

All controls necessary for operation of the Series 7600 Digital Multimeter are located on the front panel. The function of each control is outlined in Table I.

TABLE I

Front Panel Controls.

CONTROL	POSITION	FUNCTION
POWER	OFF	AC power is removed from the instrument.
	ON	AC power is applied to the instrument and the POWER switch is illuminated.
RANGE	DC AUTO	The instrument accepts any DC voltage between 0.0000 and ±999.99 volts and automatically ranges to provide the proper input attenuation and correct decimal point position for maximum resolution.
	1	1 KΩ and 1-1 RATIO ranges.
	10	10 KΩ, 10-1 RATIO, 10V DC, 10V AC, and 10 mV ranges.
	100	100 KΩ, 100-1 RATIO, 100V DC, 100V AC, and 100 mV ranges.
	1K	1000 KΩ, 1000V DC, 1000V AC, and 1000 mV ranges.
	10K	10,000 KΩ range.
SENSITIVITY	VARIABLE 0 to 100 uV (10V range)	The sensitivity control is a logarithmic taper potentiometer. At the extreme clockwise position, HI, maximum sensitivity is obtained. The sensitivity is decreased as the potentiometer is turned counterclockwise. Prior to fully counterclockwise position, LO, minimum or zero sensitivity is obtained and the instrument will not change reading.

FUNCTION	DC RATIO	The instrument indicates the ratio of the input signal to an external reference voltage. The internal reference is disconnected. Provisions are made for positive and negative external reference supplies to be connected through the signal input connector. The polarity of the external reference is automatically selected to be equal to the input signal.
	DC	The instrument measures DC only from 0.0000 to ±999.99V DC.
	AC	If an AC converter plug-in accessory, Model 6770, is inserted, the instrument measures AC only from 0 to 999.99V AC.
	MV	If a DC preamplifier plug-in accessory, Model 6880, is inserted, the instrument measures millivolts only from 0.0000 to ±999.99 mV DC.
	KΩ	If an ohms converter plug-in accessory, Model 6990, is inserted, the instrument measures resistance only from 10 mΩ to 9.9999 MΩ.
FILTER	IN	A filter is switched into the signal input circuit. The balance time is increased by a factor of 3 to 4.
	OUT	The input filter is switched out.
PRINT MODE (7650 only)	AUTO	The instrument tracks the input signal and upon reaching a null automatically issues a print command through a rear connector.
	HOLD	The logic circuits are held inoperative, suspending multimeter operation.

	TRACK	The multimeter tracks the input signal without issuing a print command.
	MANUAL	The MANUAL switch is a momentary contact closure which results in a print command signal at the time of closure. The command is issued without regard for the balance condition of the multimeter.

OPERATIONAL CHECKOUT

The operational checkout is intended as a preliminary test of operation and not to confirm performance specifications. For specifications validation refer to Section IV. Conduct an operational checkout of the multimeter as follows:

1. Position the POWER switch to OFF.

2. Insert the signal input plug into the input connector on the multimeter. Connect all input leads together.

3. Insert the power cord into a three wire, 115V AC, 60 Hz, single phase power source.

4. Position the front panel controls as follows and observe that the POWER switch illuminates:

POWER	ON
RANGE	DC AUTO
SENSITIVITY	HI
FUNCTION	DC
FILTER	OUT
PRINT MODE (7650 only)	TRACK

5. Position the RANGE switch sequentially to 10, 100, and 1K and observe that the decimal point shifts to the proper position.

6. Position the RANGE switch to DC AUTO and connect a battery between the red and black leads of the input cable. Observe that the multimeter indicates the voltage and polarity of the battery.

7. Reverse the polarity of the input voltage and observe that the multimeter indicates the change.

NOTE

Zero indications with input leads shorted will be only within specification.

8. Remove the input leads from the battery and connect the leads together. Observe that the multimeter indicates 0.0000.

9. Position the FUNCTION switch to DC RATIO and sequentially position the RANGE switch to 1, 10, and 100. Observe that the decimal point shifts to the proper position.

10. Connect the test setup as shown in figure 3-1.

11. Observe that the multimeter automatically selects the polarity of the reference voltage and indicates the ratio of the input voltage to the reference voltage.

12. Change the position of the most significant increment of the voltage divider sequentially from one extreme to the other.

13. Observe that either a positive or negative ratio indication can be made to appear on the multimeter.

14. Remove the input leads from the test setup and connect the input leads together. Position the RANGE switch to 10 and observe that the multimeter indicates 0.0000.

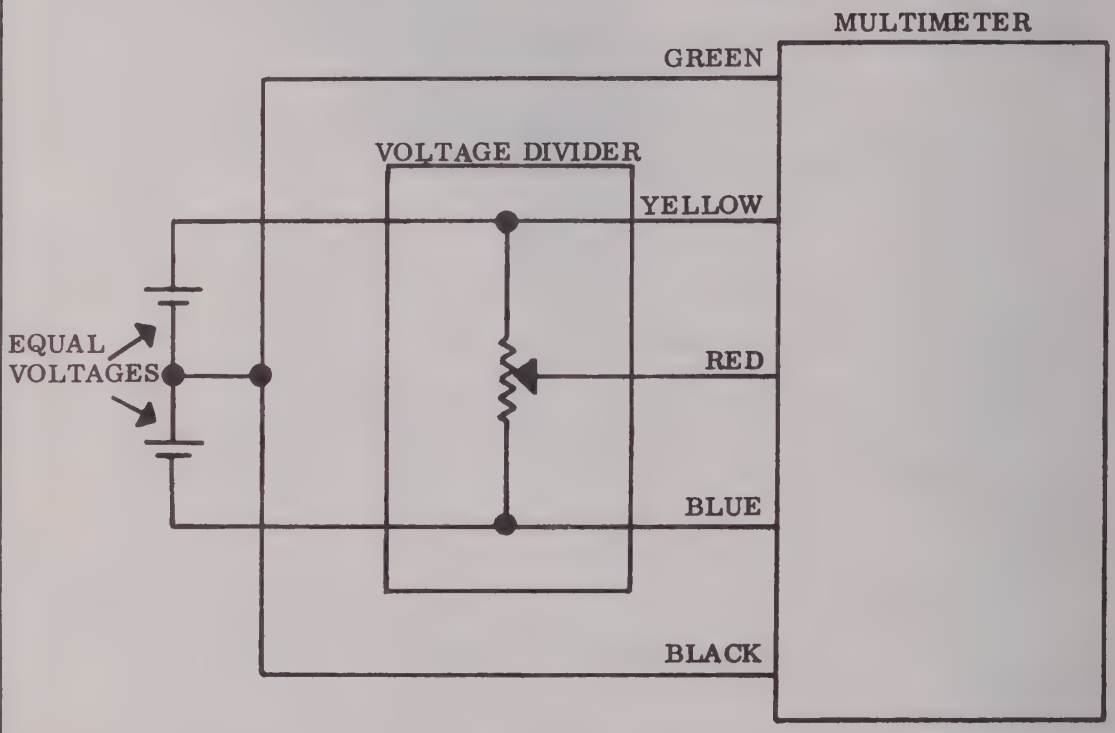


Figure 3-1. Ratio Operation Check Test Setup.

15. If the multimeter contains a DC preamplifier plug-in accessory, position the FUNCTION switch to MV and observe that the front panel MV indicator illuminates and the multimeter indicates 0.0000.

16. If the multimeter does not indicate zero, adjust the front panel MV ZERO adjustment to obtain zero.

17. Position the RANGE switch sequentially to 10, 100, and 1K and observe that the decimal point shifts to the proper position.

18. Connect a millivolt signal between the red and black leads of the input cable. Observe that the multimeter indicates the voltage and polarity of the signal directly in millivolts.

19. Reverse the polarity of the input voltage and observe that the multimeter indicates the change.

20. Remove the input leads from the millivolt signal source and connect them together. Position the RANGE switch to 10 and observe that the instrument indicates 0.0000.

21. If the multimeter contains an AC converter plug-in accessory, position the FUNCTION switch to AC. Observe that the front panel AC indicator illuminates and the multimeter indicates 0.0000.

22. Position the RANGE switch sequentially to 10, 100, and 1K and observe that the decimal point shifts to the proper position.

23. Connect an AC signal between 30 Hz and 10 KHz to the red and black leads of the input cable. Observe that the instrument indicates the value of the input voltage.

24. Remove the input leads from the AC signal source and connect them together. Position the RANGE switch to 10 and observe that the instrument indicates 0.0000.

25. If the multimeter contains an ohms converter plug-in accessory, position the FUNCTION switch to KΩ and the RANGE switch to 1. Observe that the front panel KΩ indicator illuminates and the multimeter indicates .00000.

26. If the multimeter does not indicate zero, adjust the front panel KΩ ZERO adjustment to obtain zero.

27. Position the RANGE switch sequentially to 1, 10, 100, 1K, and 10K and observe that the decimal point shifts to the proper position.

28. Connect a resistance between the red and black leads of the input cable. Observe that the instrument indicates the resistance directly in KΩ.

29. Remove the input leads from the resistance and connect them together. Position the RANGE switch to 1 and observe that the multimeter indicates .00000.

NOTE

The liability of Cimron under the warranty is negated if the instrument is improperly repaired. If trouble is experienced during the above test, refer to the appendix for warranty instructions before attempting repair.

SECTION IV

CALIBRATION AND SPECIFICATION VALIDATION

GENERAL

Prior to calibration or specification validation, the multimeter must be placed in the environment of the work area for sufficient time to allow the internal temperature to stabilize. A stabilizing time of one hour for every 10°C change in temperature is required. Excessive temperature gradients resulting from a change in environment may cause thermal voltages to be generated which could affect calibration and specification validation. Power should be applied to the instrument for approximately 60 minutes.

This section contains operational adjustment procedures, calibration procedures, and specification validation procedures for the basic DC function of the multimeter. The procedures for the plug-in accessories are located in Section VIII. The operational adjustments do not affect the accuracy of the multimeter but are necessary for proper operation. Due to interaction between adjustments, all procedures must be performed in the order given.

The initial setting of the multimeter front panel controls is given in table II. Changes from initial settings will be listed when applicable.

TABLE II

Initial Setting of Front Panel Controls.

CONTROL	SETTING
POWER	ON
RANGE	10
SENSITIVITY	HI
FUNCTION	DC
FILTER	OUT
PRINT MODE (7650 only)	TRACK

DC OPERATIONAL ADJUSTMENTS

The following equipment is required to perform the DC operational adjustments:

1. Oscilloscope (Tektronix 502 or equivalent).

2. Precision, stable, calibrated DC power supply.

3. Voltage divider (ESI DV411 or equivalent).

Figure 4-1 shows the test setup for the operational adjustments. It is recommended that the DC operational adjustments be made with a negative input to the multimeter. Figure 4-2 shows the test points located on the bottom of the instrument. Figure 4-3 shows the internal adjustments of the digital multimeter.

1. Remove the top and bottom covers of the digital multimeter. Do not remove the top shield showing the internal adjustments.

2. Connect the test setup as shown in figure 4-1. The test points are shown in figure 4-2.

3. Position the oscilloscope front panel controls for external AC trigger, 50 usec/cm time, 1 mV/cm sensitivity A, and 10 V/cm sensitivity B.

SENSITIVITY ADJUSTMENT

1. Adjust the DC power supply output to -1.0000V.

2. Adjust the voltage divider to 00070 and allow the multimeter to arrive at null.

3. Slowly increase and then decrease the setting of the voltage divider. Observe that either a positive or a negative pulse can be made to

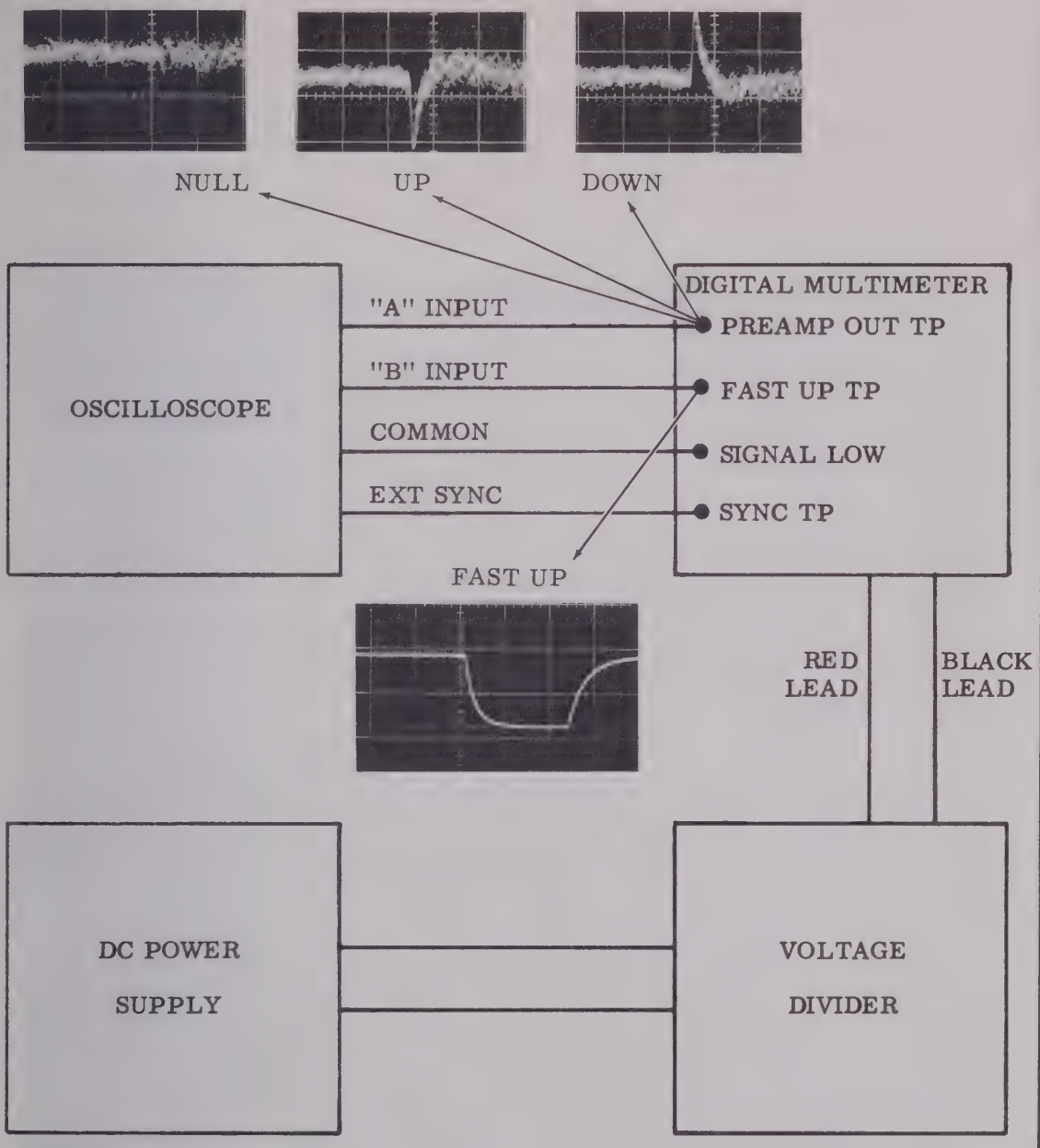


Figure 4-1. DC Test Setup.

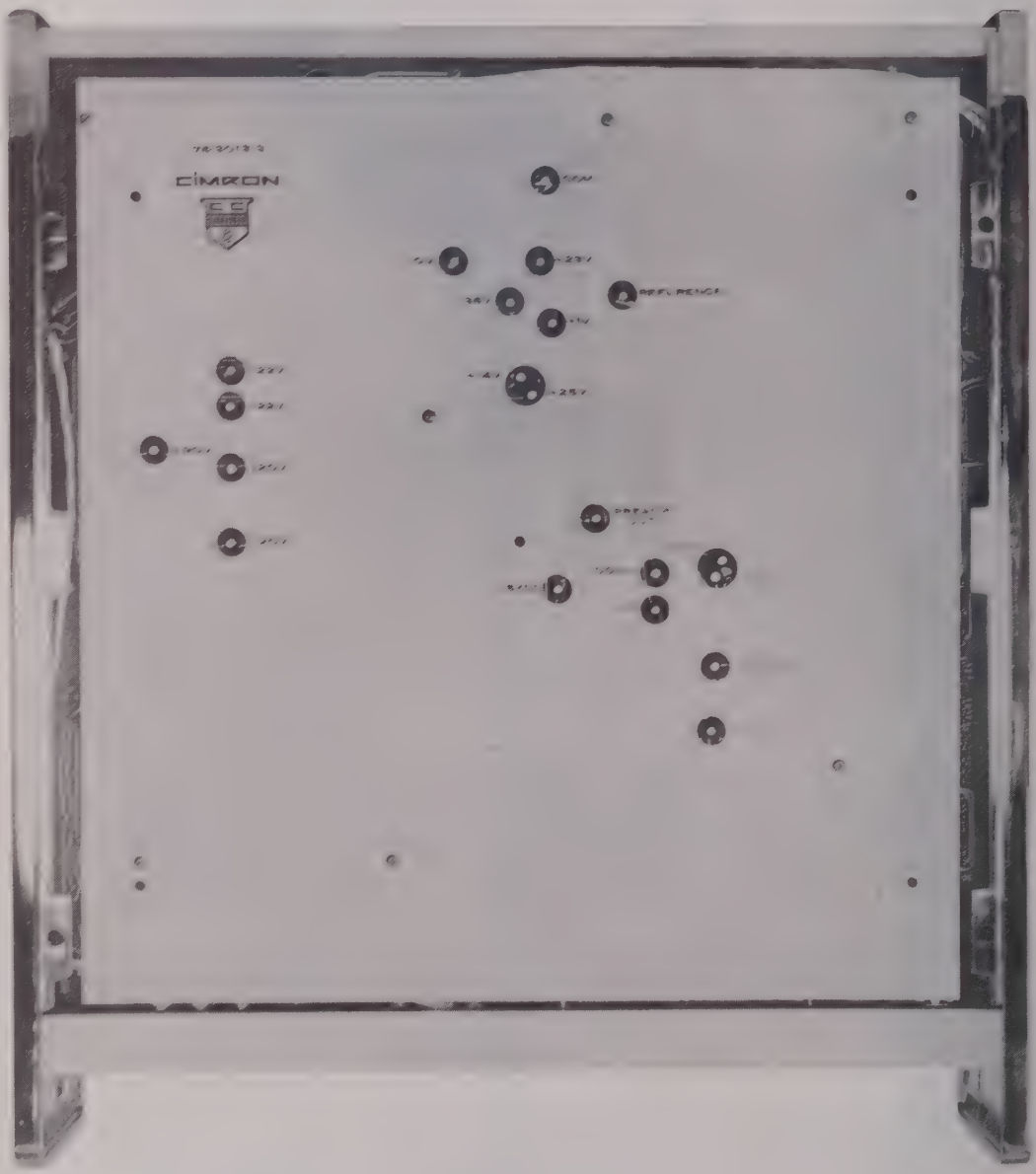


Figure 4-2. Bottom View Showing Test Points.

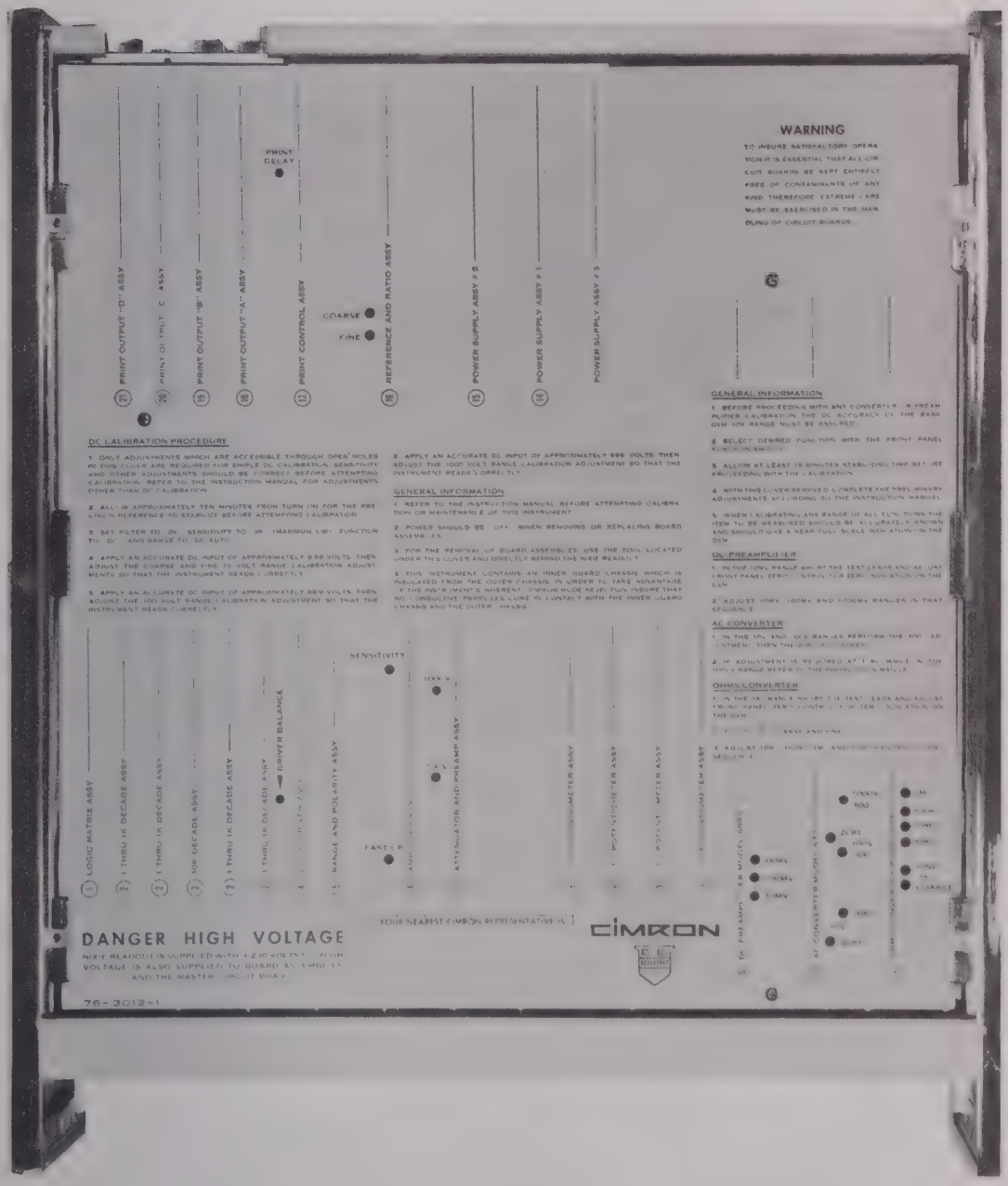


Figure 4-3. Internal Adjustments.

appear on channel A of the oscilloscope indication, which is connected to PREAMP OUT.

4. Adjust the setting of the voltage divider so that neither a positive nor a negative pulse appears as shown in figure 4-1. This is a true null.

5. Note the indication on the multimeter and the setting of the voltage divider.

6. Turn the SENSITIVITY potentiometer shown in figure 4-3 five or six turns counterclockwise. Observe that the multimeter indication has not changed.

7. Decrease the setting of the voltage divider by 00009 from the setting noted in step 5. For example, if the setting noted was 00072, the new setting would be 00063.

8. Turn the SENSITIVITY potentiometer shown in figure 4-3 slowly clockwise until the multimeter indication decreases.

9. Adjust the voltage divider slightly to obtain a true null on channel A of the oscilloscope indication.

10. Decrease the voltage divider setting by 00009. Observe that the multimeter indication decreases.

DRIVER BALANCE ADJUSTMENT

1. Adjust the voltage divider to 00070 and allow the multimeter to arrive at null.

2. Adjust the setting of the voltage divider to obtain a true null on channel A of the oscilloscope indication. Note the indication on the multimeter and the setting of the voltage divider.

3. Turn the UP BAL potentiometer shown in figure 4-3 five or six turns counterclockwise. Observe that the multimeter remains at a true null.

4. Increase the setting of the voltage divider by 00009.

5. Slowly turn the UP BAL potentiometer clockwise until the multimeter indication increases by 0.0001 or one digit. Adjust the voltage divider to obtain a true null.

6. Increase the voltage divider setting by 00009. Observe that the instrument indication increases by 0.0001 or one digit.

FAST UP ADJUSTMENT

1. Adjust the voltage divider to 00070 and allow the multimeter to arrive at null.

2. Using clip leads, short circuit both the UP and DOWN test points to COM (figure 4-2).

3. Turn the FAST UP potentiometer shown in figure 4-3 five or six turns counterclockwise. Increase the voltage divider setting by 12000 (120 mV).

4. Slowly turn the FAST UP potentiometer clockwise until a negative pulse appears on channel B of the oscilloscope indication, which is connected to FAST UP (figure 4-1).

PRINT DELAY ADJUSTMENT (Model 7650 only)

When the multimeter reaches a null and after a predetermined delay, a print command is issued. The amount of delay is adjustable. The delay may be decreased by counterclockwise rotation of the PRINT DELAY potentiometer shown in figure 4-3.

DC CALIBRATION

The following equipment is required to perform the DC calibration procedures:

1. Precision, stable, calibrated DC power supply, capable of supplying 10V, 99.950V, and 999.50V with an accuracy of ±0.005%. If an accurate DC power supply capable of 999.50V is not available, a lower voltage may be substituted. Note, however, that the accuracy of the calibration will be proportionately less as the supply voltage is decreased.

2. Voltage divider (ESI DV411 or equivalent).

INTERNAL REFERENCE CALIBRATION

1. Remove the top cover of the digital multimeter. Do not remove the top shield showing the internal adjustments.

2. Connect the test setup as shown in figure 4-4.

3. Adjust the DC power supply output to 10.000V.

4. Adjust the voltage divider to 99950.

5. Sequentially adjust the COARSE and FINE potentiometers shown in figure 4-3 to obtain a multimeter indication of 9.9950V.

ATTENUATOR CALIBRATION

1. Connect the test setup as shown in figure 4-5.

2. Position the multimeter RANGE switch to DC AUTO and adjust the DC power supply output to 99.950V.

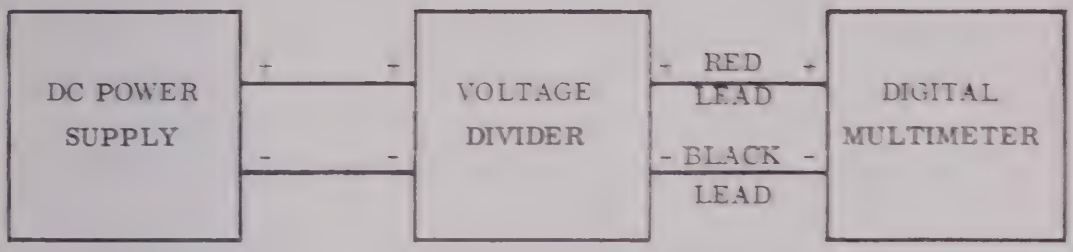


Figure 4-4. Internal Reference Calibration Test Setup.

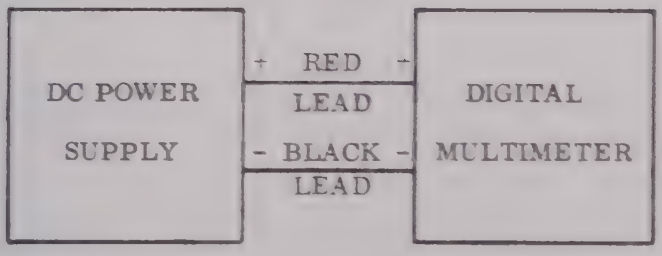


Figure 4-5. Attenuator Calibration Test Setup.

3. Adjust the 100V RANGE potentiometer shown in figure 4-3 to obtain a multimeter indication of 99.950V.

4. Adjust the DC power supply output to 999.50V.

5. Adjust the 1000V RANGE potentiometer shown in figure 4-3 to obtain a multimeter indication of 999.50V.

SPECIFICATION VALIDATION

Prior to performing the specification validation procedures, insure that the operational and calibration adjustments have been performed. Correct validation of the specifications depends upon the use of correct test equipment. Before rejecting an instrument for inability to validate the specifications, be certain the test equipment specifications are as given in the list of required equipment.

DC VALIDATION

The following equipment is required to validate the DC specifications:

1. Precision, stable, calibrated DC power supply, capable of supplying up to 999.50V with an accuracy of ±0.005%. If an accurate DC power supply capable of 999.50V is not available, a lower voltage may be substituted. Note, however, that the accuracy of the validation will be proportionately less as the supply voltage is decreased.

2. Voltage divider (ESI DV411 or equivalent).

3. Wideband audio oscillator.

4. RMS voltmeter capable of measuring 10V RMS.

5. Vacuum tube voltmeter (VTVM).

6. Ohmmeter.

7. Battery of approximately 1.5V.

8. Resistors, 1 MΩ, 1 KΩ, and 100Ω.

9. Capacitor, 1 uf.

10. Switch, SPDT.

11. Switch, SPST.

DC ACCURACY

The DC accuracy of the multimeter is specified as within 0.001% of full scale ±0.01% of reading. The DC accuracy is validated by the following procedure:

1. Connect the test setup shown in figure 4-5 and position the RANGE switch to DC AUTO.

2. Adjust the DC power supply output to +9.9950V DC and observe that the multimeter indication is +9.9950V, ±0.0010V.

3. Adjust the DC power supply output to +99.950V DC and observe that the multimeter indication is +99.950V, ±00.010V.

4. Adjust the DC power supply output to +999.50V DC and observe that the multimeter indication is +999.50V, ±000.10V.

DC INPUT RESISTANCE

The DC input resistance of the multimeter is specified as in excess of 1000 megohms at balance on 9.9999V DC range (instrument will measure voltage from

a 10 megohms source); 11 megohms independent of balance on 99.999V and 999.99V DC ranges. The DC input resistance is validated by measuring the voltage drop across a resistor in series with the signal input.

NOTE

Input shielding may be necessary in a noisy environment. A 1 uf capacitor is used as a shunt path for stray noise which would otherwise be developed across the high source impedance.

1. Connect the test setup shown in figure 4-6.

2. Adjust the DC power supply output to 10.000V.

3. Adjust the voltage divider setting to 99995 and observe that the multimeter indication with S1 closed is 9.9995V.

4. Observe that the multimeter indication E_m with S1 open decreases by 100 digits (0.01V) or less.

5. Close S1 and observe that the multimeter indication is the same as step 3.

6. The voltage drop across the resistor, ΔE, is the indication in step 3 minus the indication in step 4. A ΔE of 0.0100 represents a 1000 MΩ input resistance at DC as shown in steps 7 and 8.

7. Input current $= \frac{\Delta E}{10^6}$

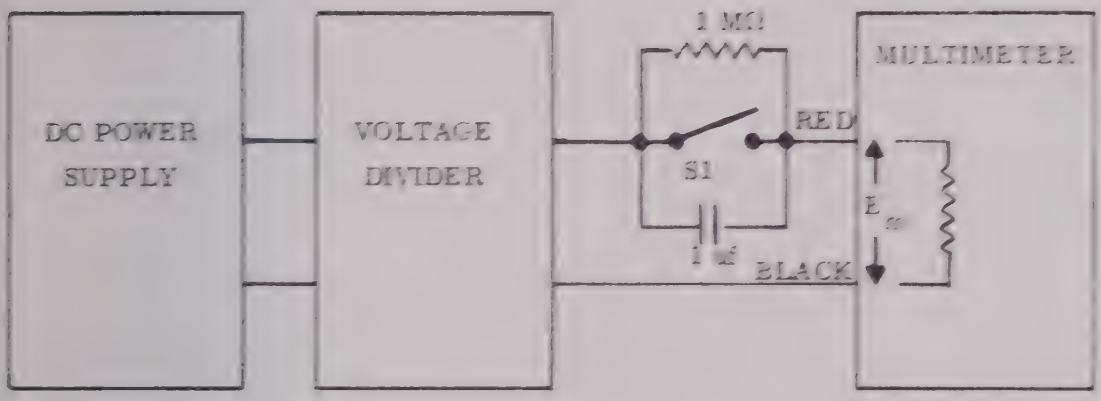


Figure 4-6. Input Resistance Validation Test Setup.

8. Input resistance $= \dfrac{E_m}{\text{Input Current}}$

$$= \frac{E_m}{\frac{\Delta E}{10^6}}$$

$$= \frac{E_m}{\Delta E} \cdot 10^6 \Omega$$

COMMON MODE REJECTION

The following procedure is used for both AC and DC common mode rejection validation. The AC common mode voltage source is 60 Hz from an audio oscillator. The DC common mode voltage source is a DC power supply. If the common mode voltage is E_{cm} and the least significant digit change is defined as the error voltage E_e, the common mode voltage rejection ratio is expressed in decibels by the following formula:

$$\text{Common Mode Rejection} = 20 \log \frac{E_{cm}}{E_e}$$

1. Measure the resistance between signal LO (black lead) and chassis ground with the POWER switch positioned to ON. Chassis ground is available at the GROUND binding post on the multimeter front panel. The measurement must indicate infinity. Correct any short or leakage between signal LO and chassis ground before proceeding with the test.

2. Connect the test setup shown in figure 4-7 and adjust the output of the common mode voltage source to OV.

3. Note the indication on the multimeter.

CAUTION

Do not increase the common mode voltage beyond 500V. If this caution is not observed, damage to the multimeter may result.

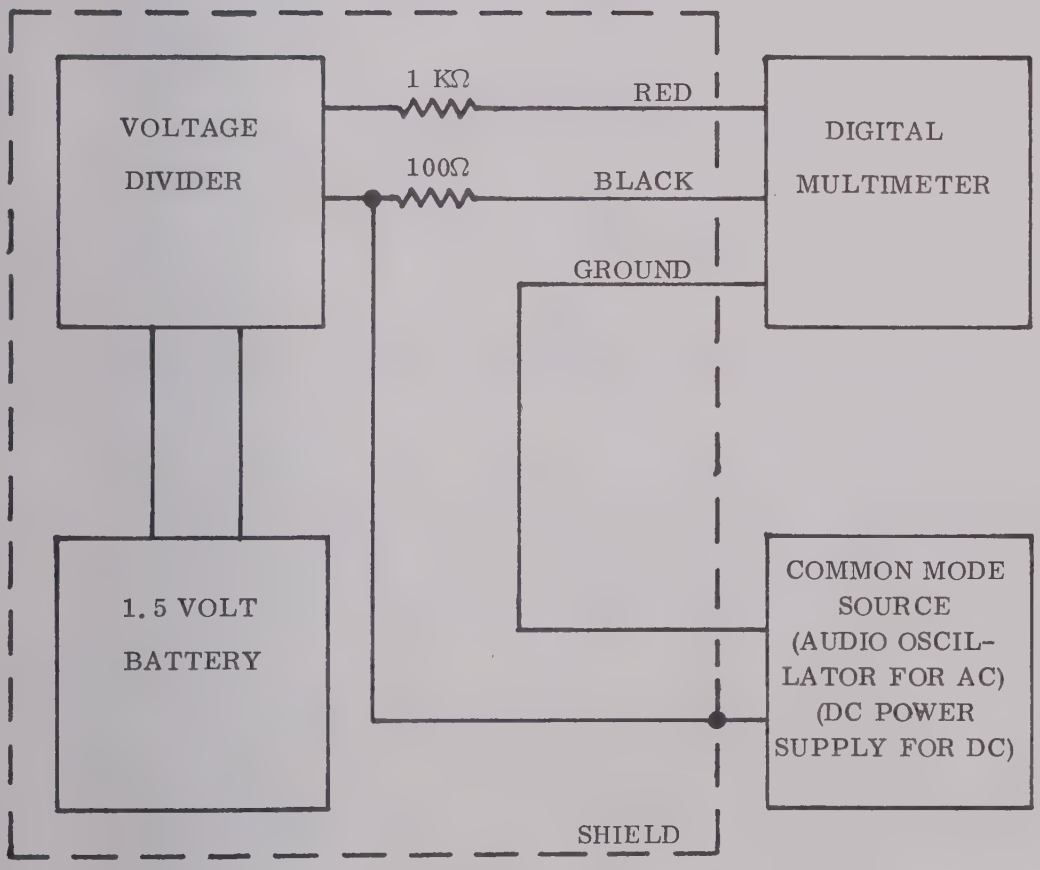


Figure 4-7. Common Mode Rejection Validation Test Setup.

4. Slowly increase the output of the common mode voltage source until the least significant digit of the multimeter indication becomes unstable.

5. Adjust the voltage divider for stabilization of the instrument.

6. Repeat steps 4 and 5 until the voltage divider is no longer able to stabilize the instrument.

7. Determine the common mode rejection ratio of the multimeter according to table III.

TABLE III

Common Mode Rejection Ratio $\frac{E_{cm}}{E_e}$ in dB.

	E_e 0.1V	0.01V	0.001V	0.0001V
$*E_{cm}$				
1V	20 dB	40 dB	60 dB	80 dB
5V	34 dB	54 dB	74 dB	94 dB
10V	40 dB	60 dB	80 dB	100 dB
50V	54 dB	74 dB	94 dB	114 dB
100V	60 dB	80 dB	100 dB	120 dB
500V	74 dB	94 dB	114 dB	134 dB

$*E_{cm}$ is indicated as volts DC or volts peak-to-peak AC.

RATIO OPERATION

The Series 7600 Digital Multimeter is designed to compare an unknown input voltage with a known external reference voltage. The ratio is indicated directly as a quotient.

1. Connect the test setup shown in figure 4-8 with S1 connecting the voltage divider HI to EXT REF +.

2. Position the RANGE switch to 1 and the FUNCTION switch to DC RATIO.

3. Adjust the DC power supply output to 10.000V.

4. Adjust the voltage divider to 99990 and observe that the multimeter indication is the same as the voltage divider setting within ±.00007.

5. Adjust the DC power supply output to 100.00V and observe that the multimeter indication is the same as the voltage divider setting within ±.00070. The front panel SENSITIVITY control must be turned counterclockwise until a stable reading is obtained.

6. Adjust the DC power supply output to 10.000V.

7. Adjust the voltage divider to 55550 and observe that the multimeter indication is the same as the voltage divider setting within ±.00005.

8. Adjust the voltage divider to 11110 and observe that the multimeter indication is the same as the voltage divider setting within ±.00003.

9. Position S1 to connect the voltage divider HI to EXT REF -, and repeat steps 3 through 8 for a minus ratio.

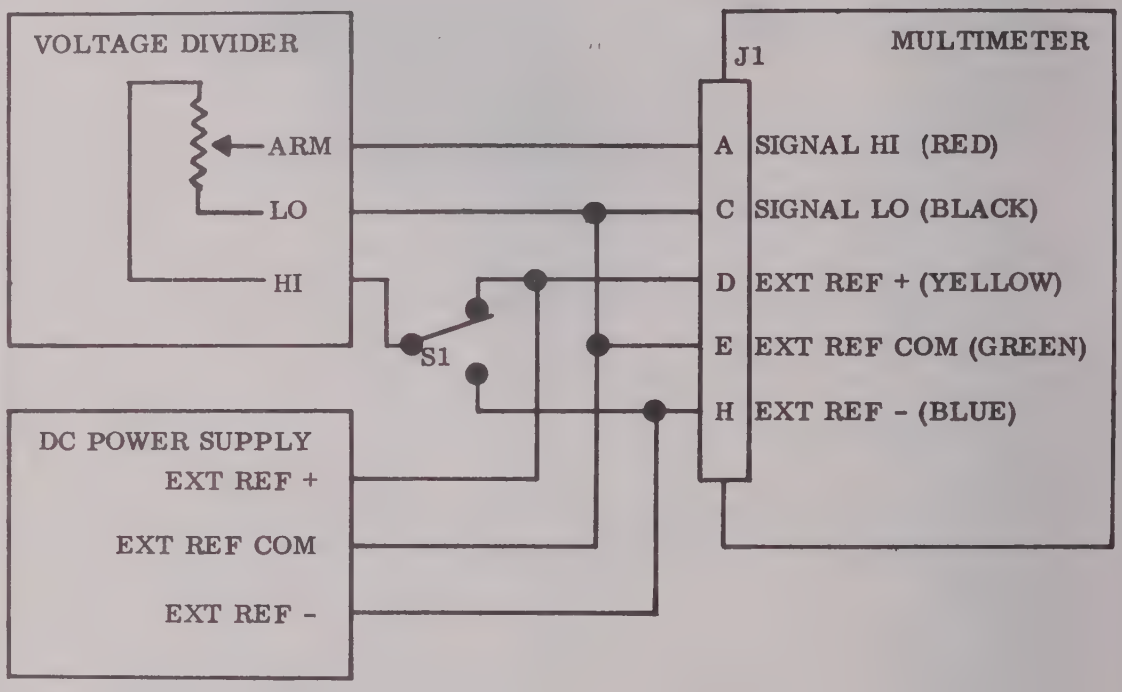


Figure 4-8. Ratio Operation Test Setup.

FLOATING INPUT

The five input leads of the multimeter input cable are isolated from the multimeter case, power line ground, and the print output.

1. Connect the five input leads together.

2. Connect an ohmmeter between the input leads and the multimeter case and observe that the resistance is indicated as infinity.

3. Position the multimeter FUNCTION switch to DC AUTO and sequentially position the RANGE switch to each and every position, observing at each position that the resistance is indicated as infinity.

4. Repeat step 3 with the FUNCTION switch positioned to DC, AC, MV, and KΩ.

5. Connect the ohmmeter between the input leads and power line ground and repeat steps 3 and 4.

6. Model 7650 only - Connect the ohmmeter between the input leads and the print output and repeat steps 3 and 4.

SECTION V

THEORY OF OPERATION

GENERAL DESCRIPTION

The Series 7600 Multimeter, with plug-in accessories, measures DC voltages, DC ratios, AC voltages, DC millivolts, and resistances. The multimeter utilizes plug-in accessories to convert the AC, mV, or resistance inputs to DC voltages measurable by the basic DC portion of the multimeter. The theory of operation of the plug-in accessories is contained in Section VIII.

The basic DC portion of the multimeter is essentially a closed loop servo system. A stable, internally-generated reference voltage is developed across a series of narrow-tolerance resistors which comprise the precision reference potentiometer. The logic of the instrument drives the potentiometer arm until the sum of the incremental voltage steps equal the unknown voltage value. The multimeter front panel nixie tube indicators display the incremental changes of the precision voltage as they are sensed by the potentiometer arm. When a state of balance between the sum of the precision voltage incremental changes and the unknown voltage value is attained, the potentiometer arm stops moving. The value displayed by the front panel indicators represents the unknown voltage value.

Potentiometer positioning and readout of the unknown voltage is accomplished by the servo system activated by the difference sensed in a voltage comparison circuit (figure 5-1). Voltage comparison is accomplished by an electromechanical chopper which samples the unknown voltage and the reference voltage alternately approximately 180 times per second. These two voltages are compared by the chopper which produces an output pulse that is proportional in phase and amplitude to the difference between the two values. The difference or error voltage sensed

by the chopper is applied to a transistor error amplifier where it is amplified and properly polarized with respect to the reference voltage. A second amplifier further amplifies and directs the error signals to three logic circuit inputs: i.e., UP, DOWN or FAST-UP drivers. The outputs of the three drivers are directed by the logic matrix to the appropriate binary decade assemblies which cause the potentiometer to null. Neon indicator tubes in the readout, monitor the position of the potentiometer arm and indicate the decimal equivalent of the analog of the input voltage.

CIRCUIT DESCRIPTION

The following description relates the theory of operation of each assembly comprising the Series 7600 Multimeter. The drawings referenced in parenthesis after each assembly title are the associated assembly schematic drawings located in Section VI. Figure 5-2 is a block diagram of a basic Series 7600 Multimeter showing the relation of assemblies to each other. The diagram does not show the power supply, print control, or print output assemblies.

POTENTIOMETER (See drawings 76-0719 and 76-0720)

There are four boards in this assembly, arranged as two complementary rheostats connected in a modified Wolff bridge configuration (figure 5-3). As the nulling section of the potentiometer is switched from 0 to 100,000 ohms, the balancing section is varied inversely. This maintains a constant impedance to the reference source and diminishes the possibility of reference instability due to load variation. Nulling of the unknown and reference voltages is accomplished by switching potentiometer component resistors in or out of the series circuit in accordance with commands from the binary decade assemblies.

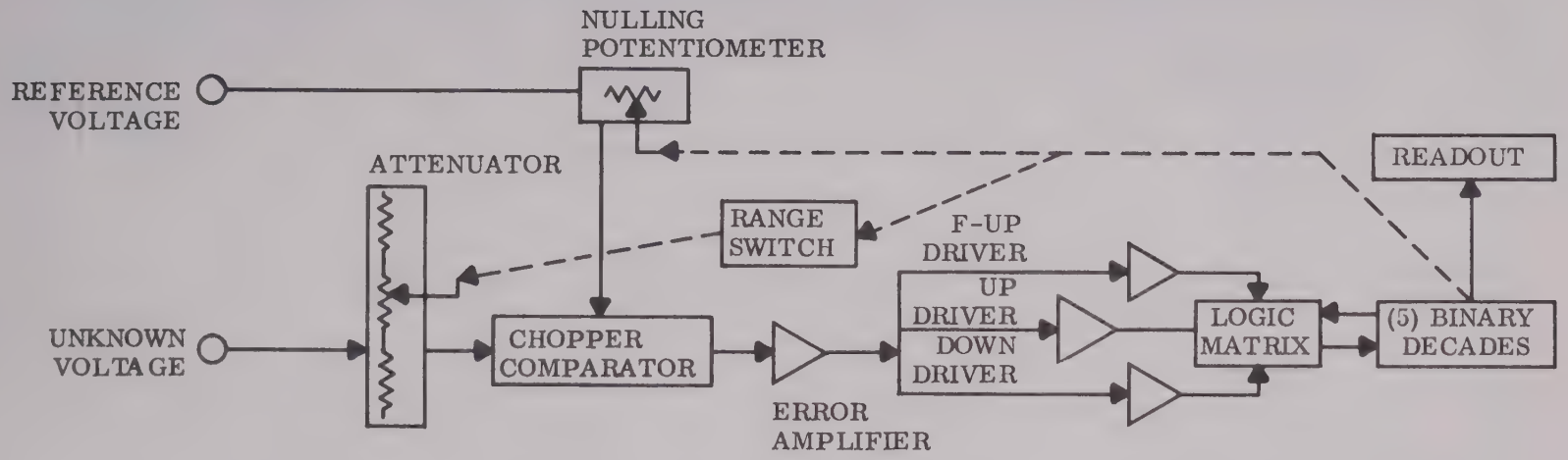


Figure 5-1. Simplified Block Diagram of Voltmeter Closed Loop Servo System.

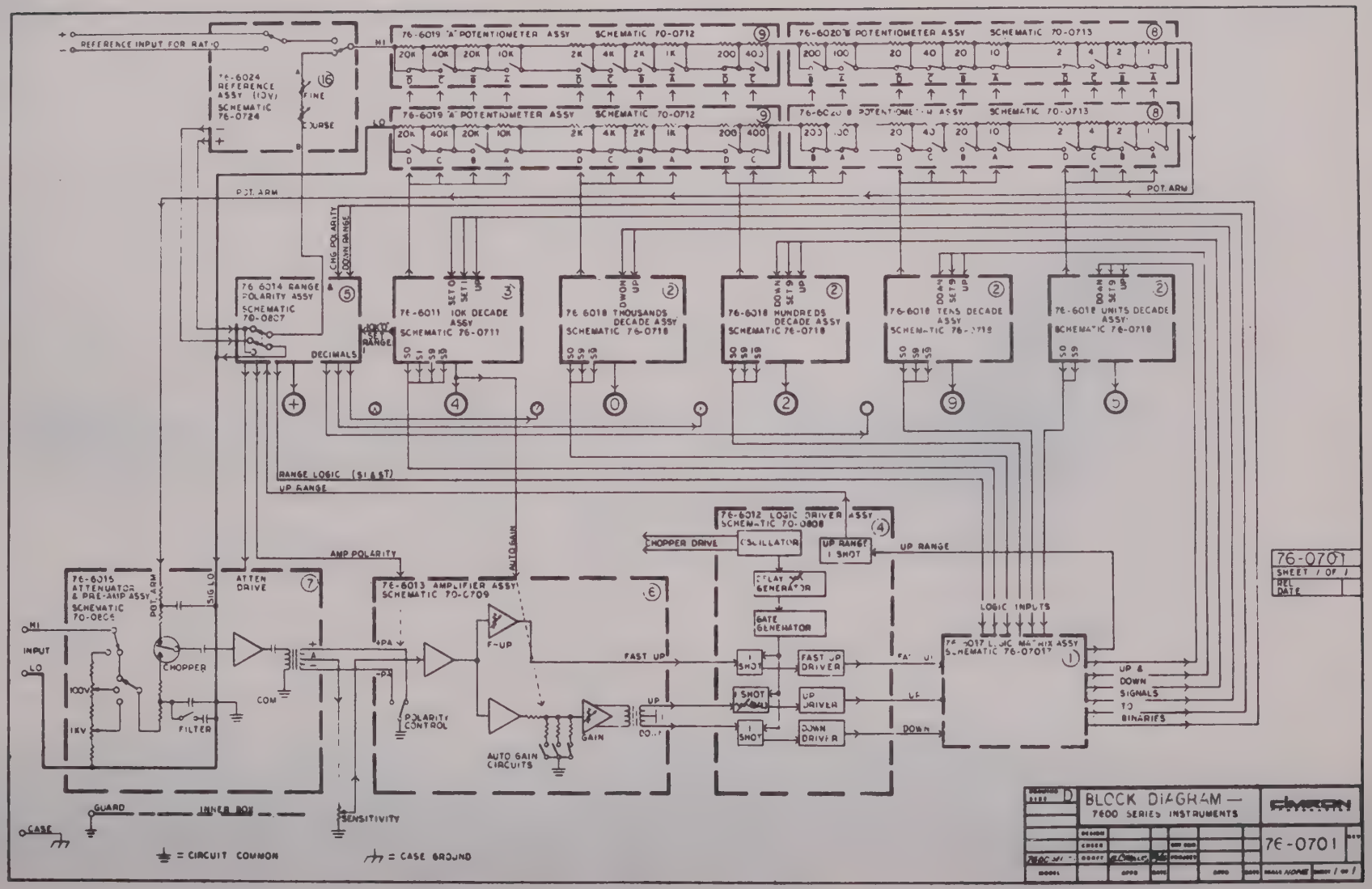


Figure 5-2. Block Diagram, Typical Series 7600 Instrument.

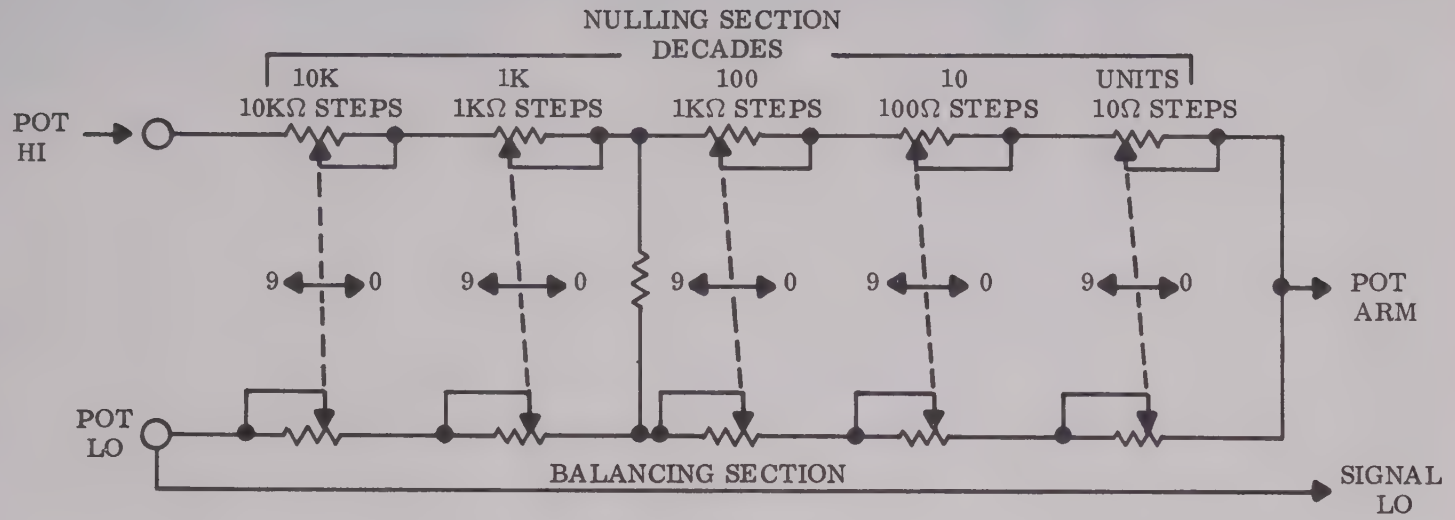


Figure 5-3. Modified Wolff Potentiometer.

Each decade assembly commands a four resistor balancing and a four resistor nulling section of the potentiometer. The commands issued by the decades are in the form of 1-2-4-2' BCD which activate reed switches to adjust the value of the potentiometer. The block diagram, figure 5-2, shows the potentiometer switched to correspond to an indicated decimal reading of 40295.

The "0" state of the counting binaries in the decade assemblies are their low voltage output condition, i.e., transistor biased on. The "1" state output is approximately +17 volts. When a binary is in the "0" state, an associated reed switch is turned on, shorting out a corresponding section of the potentiometer. The nulling section of the potentiometer is controlled by the $\overline{A}$, $\overline{B}$, $\overline{C}$ and $\overline{D}$ (not A, not B, not C and not D) outputs of the decades while the balancing section is controlled by the A, B, C and D sections. Whenever an A, B, C or D output of a binary is in the "0" condition, its $\overline{A}$, $\overline{B}$, $\overline{C}$ and $\overline{D}$ counterparts are in the "1" condition. Figure 5-2 illustrates that a decimal reading of 5 requires that binary outputs $\overline{A}$, $\overline{B}$, C and $\overline{D}$ close their relays and A, B, $\overline{C}$ and D open. At a reading of 00000, the $\overline{A}$, $\overline{B}$, $\overline{C}$ and $\overline{D}$ reeds are all open ("1" output condition) and for a reading of 99999 these reeds are all closed ("0" output condition).

ATTENUATOR AND PRE-AMP (See drawing 76-0716)

The voltage to be measured is applied to a relay controlled attenuator which may be controlled manually or automatically to accommodate the amplitude of the signal. Since the reference voltage is 10 volts, the range of the voltmeter is basically 9.9999 volts. Larger input or signal voltages are attenuated 10 or 100 times to provide measuring ranges of 100 or 1000 volts respectively. A filter network, with a sharp response at 60 cps, is incorporated in the output of the attenuator. When required, additional filtering is available which may be added manually. With the additional filter added, the reading time of the instrument is increased, since it is a function of the response time of the filter. The output of the logic controlled potentiometer (reference voltage) is also connected to this assembly. An electromechanical chopper compares the input signal and the reference voltage approximately 180 times per second. The chopper output is a square pulse proportional to the amplitude and polarity difference of the compared voltages. The pulse is differentiated and applied to the input of a low noise amplifier which provides approximately 30 dB gain and signal polarization. The amplifier output

is transformer coupled. The center tap of the secondary winding of the transformer is wired to a front panel mounted SENSITIVITY potentiometer which provides excitation for the next assembly.

AMPLIFIER (See drawing 76-0713)

The output of the SENSITIVITY control provides the signal input for this assembly. Start and finish of the secondary winding of the pre-amp output transformer are connected to two transistor switches Q1 and Q2, which on command from the range and polarity assembly ground one end or the other to maintain proper polarity relationship with the reference voltage. This circuit is necessary to accommodate polarity reversal of the input signal.

The signal input drives an emitter follower stage, Q5 which furnishes input for two amplifiers, one of which, Q4, is designated FAST-UP. When an error signal of greater than approximately 1.2% of full scale exists in the "up" direction, i.e., toward an increasing reading, the FAST-UP amplifier drives a separate driver system whose sole function is to provide a shortcut in the logic for large up errors.

The other amplifier Q6, driven by the emitter follower, provides approximately 20 dB gain and a low output impedance to drive the auto gain attenuator. The three attenuator sections are selected by transistor switches which are controlled by the 2 through 9 decimal output of the 10K (most significant digit) decade. The auto gain circuit improves stability of the instrument by reducing system sensitivity as the readout approaches full scale.

The auto gain circuit consists of resistors R29, R30, R32 and R34 and the auto gain attenuator switches Q8, Q9 and Q10. The transistors are normally biased to cutoff by +25 volts through resistors R16, R17 and R18.

All three auto gain switches operate in the same manner, providing various amounts of attenuation depending on the decimal count of the 10K decade.

When, for example, the 10K decade registers a count of 3, decimal output 3 approaches ground potential and removes the reverse bias to Q8 through the diode CR2. This reverse bias is normally supplied through resistor divider R16, R25 and R28. As Q8 saturates, it connects R30 to circuit common. The attenuator output from the junction of R29 and R30 is applied to the input of Q11.

Amplifier stage (Q11) has a gain adjustment in the emitter circuit. The output is coupled to an inverting amplifier, which in turn is transformer coupled to a pair of emitter followers, Q15 and Q16. Q15 provides output for the UP driver and Q16 provides output for the DOWN driver.

LOGIC DRIVER (See drawing 76-0712)

The logic driver assembly provides the following signals: UP RANGE drive, UP drive, DOWN drive, FAST-UP drive, gating pulses and the chopper drive.

The oscillator consisting of Q1 and Q2 is an astable multivibrator which provides an output pulse of approximately one millisecond at a repetition rate of approximately 180 times per second. The pulse width and frequency are determined by C1, R5, C2 and R6. Two switching transistors, Q9 and Q10, provide buffering between the chopper and the oscillator.

The multivibrator output is also fed to the gate flip-flop, transistors Q3 and Q4, connected as a bistable multivibrator. The trailing edge of the pulse from Q2 triggers the bistable multivibrator which generates a gating pulse for the UP, DOWN and FAST-UP drivers.

The UP, DOWN and FAST-UP drivers consist of one-shot multivibrators, each driving one output amplifier (Q17, Q8, and Q21 respectively). Since all drivers are identical, only one is discussed in detail. The one-shot section of the UP driver, consisting of Q14 and Q16, is held inoperative by gating transistor Q15. When the gate flip-flop pulse drives the base of Q15 positive, Q14 is

triggered if a positive error signal is at its base. This input signal is the UP output of the preceding amplifier. When Q14 fires, Q16 cuts off and couples a signal to Q17, the UP output driver which is normally cut off. This causes a negative pulse output of approximately 25 volts at the collector of Q17. This pulse is fed to the logic matrix for direction to the proper decade.

The three drivers are positively interlocked in such a manner that if the DOWN driver fires, the UP and FAST-UP drivers are disabled. When the UP driver fires, the DOWN driver is disabled. The FAST-UP driver does not provide an interlock because the UP driver always fires when the FAST-UP driver fires. The DOWN driver fires independently.

When a down pulse is applied to the input of the DOWN driver through C6, its output amplifier Q8 becomes saturated. The negative potential from the collector of Q8 is applied to the base of Q3, resetting the gate flip-flop and turning off the gate. Thus, the UP driver and FAST-UP driver cannot fire during the duty cycle of the DOWN driver. When an up pulse is applied to the UP driver through C17, its output amplifier, Q17, becomes saturated, the negative potential from the collector of Q17 is applied to the base of Q3, turning off the gate. Thus, the DOWN driver cannot fire during the duty cycle of the UP driver. When the FAST-UP driver is firing the UP driver is also firing, which interlocks the DOWN driver.

The trigger level of the one-shot in the UP driver is controlled by BALANCE potentiometer R59, used to equalize the level at which the UP and DOWN drivers fire.

The UP-RANGE driver is a monostable multivibrator connected between the logic matrix and the range and polarity assembly. The monostable delays consecutive UP-RANGING signals long enough to allow the input filter to reach equilibrium and prevent erroneous DOWN RANGING. The time constant of this one-shot is controlled by relay K11 (open for FILTER IN) to accommodate input filter characteristics.

LOGIC MATRIX (See drawing 76-0717)

The logic matrix consists of three networks of resistors and diodes which direct signal pulses from the logic driver assembly to the correct inputs of the five decades or the range and polarity circuits. Each of the decades and the range and polarity assembly have logic outputs which enable the logic matrix to determine which unit should receive a particular drive pulse. The logic signals to the matrix are termed shift signals, identified by the letter "S" followed by a numeral. The logic signals have two possible states, "go" or "no go". In some cases, complementary logic signals are required. These are identified by $\overline{S}$ or NOT SHIFT. All logic signals are connected to the logic matrix together with the FAST-UP, UP, and DOWN signals from the logic driver. Shift signals in the "no go" condition provide diode clamps on unwanted matrix output signals. The logic automatically directs pulses to the proper counting circuits. Refer to paragraph entitled LOGIC DETAIL for further explanation of counting sequences.

UNITS, 10, 100 and 1K DECADES (See drawing 76-0718)

Each of these four identical and interchangeable assemblies consists of a four binary 1-2-4-2′ BCD counter, a BCD-to-decimal decoder, decimal readout drivers, and the required logic shift circuits. The 10, 100, and 1K decades provide S0, S9 and $\overline{S9}$ shift outputs for the logic matrix while the units decade provides only S0 and S9. Each decade except the 1K decade accepts UP, DOWN and FAST-UP inputs. The 1K decade accepts only UP and DOWN inputs.

Each of the four counting binary circuits on a decade assembly has two complementary BCD outputs. These 1-2-4-2′ BCD outputs operate the reed relays to establish the value of the nulling potentiometer, in the manner discussed in the paragraph headed POTENTIOMETER.

The BCD to decimal decoder translates, through a diode matrix, the 1-2-4-2′ BCD information contained in the decade assembly into ten digit 0-9 decimal information which is used to drive the neon indicators through transistor drivers Q12 through Q21.

Assume the decade assembly is registering a 0 count. Q7, Q5, Q3 and Q1 are turned on, i.e., conducting and their collectors are near zero volts. Q8, Q6, Q4 and Q2 are turned off; their collectors are at approximately +17 volts. Decimal decoder diodes CR27, CR32, and CR41 are back biased. The base of transistor Q12 is biased in a forward direction from +23 volts through R54. The emitter is forward biased through Q23. Q12 is saturated and the 0 neon indicator is on. The binary outputs $\overline{A}$, $\overline{B}$, $\overline{C}$ and $\overline{D}$ are all "no go". When an UP pulse is directed to the decade by the matrix, it is applied through CR47, C6, and C7 to steering diodes CR18 and CR19 of binary A. Since the UP pulse is negative in polarity it is directed to the base being held positive by the binary cross-over network, in this case Q7. Q7 is turned off. As the collector of Q7 becomes positive, it forward biases Q8 which becomes saturated. As Q8 saturates it turns off Q23 through diode CR49. Q12 is reverse biased by +23V at the emitter through R66 and R67, turning off the 0 neon indicator. Q22 is turned on by +23V at the base through R71. Q13 becomes saturated because of reverse bias across the decoder diodes CR27, CR32, and CR41 and forward bias at the emitter through Q22, the 1 neon indicator is turned on. The binary output is now $\overline{B}$, $\overline{C}$, $\overline{D}$ "no go" and $\overline{A}$ "go". On the next UP pulse, Q8 is turned off. Q7, in turning on, furnishes a negative pulse through C1 and diode CR2 to the base of Q1 in the D binary, and through C4 and C5 to the steering diodes in the B binary. Q1 is turned off and Q2 turned on in the D binary. A positive pulse, present at the collector of Q2, is returned through CR10 and R44 to the steering diodes in binary B. The feedback prevents binary B from being affected by the negative pulse from binary A. The binary outputs are now $\overline{A}$, $\overline{B}$, $\overline{C}$ "no go" and $\overline{D}$ "go". The decimal decoder causes the numeral 2 neon indicator to light. The D binary will remain in its present condition until it is reset to 0 by a down pulse. The third up pulse turns Q8 on and turns Q7 off. The positive pulse at the collector of Q7 does not affect the B or D binaries because of the polarity of the steering diodes CR2, CR13 and CR14. The fourth UP input pulse turns Q7 on and Q8 off. The negative pulse at Q7 is coupled to binary B through C4 and C5. Q6 is turned on and Q5 is turned off bringing the binary count to $\overline{A}$, $\overline{C}$ "no go" and $\overline{B}$, $\overline{D}$ "go". The decimal decoder causes neon indicator numeral 4 to light. The fifth UP input pulse causes A binary to change state; turn Q7 off and Q8 on. Since the pulse generated at the collector of Q7 by this change of state is positive, it does

not affect the state of any of the other binaries. The sixth UP pulse again changes the state of the A binary, which presents a negative pulse to the B binary. The B binary changes state, sends a negative signal to the C binary steering diodes, and binary C changes state. Q3 turns off and Q4 turns on. The binary output is now $\overline{D}$, $\overline{C}$ "go". The seventh UP pulse changes state of the A binary, turning Q7 off and Q8 on, but since the output of the A binary is positive none of the other binaries are affected. The eighth UP pulse changes the state of the A binary, causing Q6 in the B binary to conduct and Q5 to be turned off. Binary outputs are now $\overline{B}$, $\overline{C}$, $\overline{D}$ "go". The ninth UP pulse changes the state of binary A again while not affecting any others. The binary outputs are $\overline{A}$, $\overline{B}$, $\overline{C}$, $\overline{D}$ "go".

Each decade assembly contains two shift circuits. One consists of transistor Q11 (S0). When the binaries are in the zero count with Q2, Q4, Q6 and Q8 turned off, diodes CR26, CR31, CR40 and CR46 are reverse biased, allowing Q11 to produce a "go" signal at S0 output. When the decades are registering any count other than 0, the 0 shift transistor is biased on and the S0 output is "no go".

The other shift circuit consists of a conventional binary Q9 and Q10, and transistor switches Q24 and Q25. When the counting binaries are registering any count other than 9, the shift binary is held inoperative by reverse bias on CR23 and the S9 output is "no go". Switching transistor Q24 is biased on to produce a "go" $\overline{S9}$ output. When the counting binaries reach a count of 9, reverse bias is removed from CR23 through decoding diodes CR34, CR39, and CR45. CR19 is reverse biased in the A binary, preventing the decade from further counting. Switching transistor Q25 is biased on to produce a "go" S9 output. At this point the decade can only accept DOWN pulses. A DOWN pulse resets all binaries so the binary count is $\overline{A}$, $\overline{B}$, $\overline{C}$, $\overline{D}$ "no go" and decimal output is 0.

Table IV shows the counting sequence and the binary conditions for each decimal and BCD count.

Table IV. Count Sequence and Binary Conditions.

BINARY OUTPUT	DECIMAL EQUIVALENT										BCD COUNT
	0	1	2	3	4	5	6	7	8	9	
A	-	+	-	+	-	+	-	+	-	+	1
$\overline{A}$	+	-	+	-	+	-	+	-	+	-	
B	-	-	-	-	+	+	-	-	+	+	2
$\overline{B}$	+	+	+	+	-	-	+	+	-	-	
C	-	-	-	-	-	-	+	+	+	+	4
$\overline{C}$	+	+	+	+	+	+	-	-	-	-	
D	-	-	+	+	+	+	+	+	+	+	2′
$\overline{D}$	+	+	-	-	-	-	-	-	-	-	

\+ = Binary turned off, Collector at +17V

\- = Binary turned on, Collector at 0V

Counting Sequence

DECIMAL EQUIVALENT	TURNED ON	TURNED OFF
1	$\overline{A}$	$\overline{B}\,\overline{C}\,\overline{D}$
2	$\overline{D}$	$\overline{A}\,\overline{B}\,\overline{C}$
3	$\overline{A}\,\overline{D}$	$\overline{B}\,\overline{C}$
4	$\overline{B}\,\overline{D}$	$\overline{A}\,\overline{C}$
5	$\overline{A}\,\overline{B}\,\overline{D}$	$\overline{C}$
6	$\overline{C}\,\overline{D}$	$\overline{A}\,\overline{B}$
7	$\overline{A}\,\overline{C}\,\overline{D}$	$\overline{B}$
8	$\overline{B}\,\overline{C}\,\overline{D}$	$\overline{A}$
9	$\overline{A}\,\overline{B}\,\overline{C}\,\overline{D}$	

10K DECADE (See drawing 76-0711)

With the exception of minor input and output variations this decade and its counting sequence is identical to the ones described in the preceding paragraphs. There are three inputs: UP, SET 0 and SET 1. The UP is the normal counting input. The SET 0 input resets the decade to the 0 count from any other count and the SET 1 input resets the decade to a count of 1 from any other count. An additional output, S1, from transistor Q12, is applied to the matrix when the decade is registering a 1 count in the same manner as S0 in the other decades.

RANGE AND POLARITY (See drawing 76-0714)

The polarity section of this assembly consists of a conventional bistable multivibrator Q3 and Q4, actuating two of four transistor switches in either of its stable states. Q1 and Q2 reverse the polarity of the reference voltage supplied to the potentiometer each time the binary changes state, and Q5 and Q6 change polarity readout. The binary collectors are also connected to the amplifier assembly for polarity referencing of the error signal. When all decade units are sensed by the logic matrix to be in the 0 count condition and the range binaries are in the 1 (10 volt) range, the logic matrix will pass the next down pulse to the polarity binary. This causes the polarity binary to change state, reversing the polarity of reference, amplifier and readout. Each time a down signal is received by the polarity binary, it will change state and reverse the polarity of reference, amplifier and readout.

The range section of this assembly consists of two binary pairs: Q10, Q11 and Q12, Q13, tied together to produce three sequential decimal outputs by means of a BCD to decimal decoder consisting of CR19, CR20, CR22, CR23, CR24, CR25, and CR26 and three transistor switches Q15, Q16, and Q17. Another pair of transistor switches, Q8 and Q9, furnish logic inputs of S1 and $\overline{S1}$ to the matrix. The decimal outputs actuate attenuator switching relays and neon range indicators while the shift outputs provide condition identification to the matrix.

Two inputs, 10K 0 and SET R1, force the binaries into range 1 (10 volts) thereby keeping the instrument locked in the range 1 position when the 10K decade

is registering 0 or the FUNCTION switch is in the AC, MV, or KΩ position. When either of these conditions exist the forward bias is removed from Q14 and it is cut off. With Q14 in the cutoff condition, both range binaries are held inoperative and forced to issue a range 1 command output.

The range binaries cause the attenuator and indicators to UP RANGE when all decades are registering a 9 count and additional UP pulses are present. The logic SHIFT 9 input unclamps the UP signal supplied to the matrix passing it to the range binaries. The range binaries cause the attenuator and indicators to DOWN RANGE when the units through 1K decades register a count of 0 and the 10K decade registers a count of 1. This unclamps the down signal supplied to the matrix which now passes a down signal to the range binaries.

Any down signal resets the range binaries to range 1 condition from any other condition while an UP RANGE signal advances from 10 volt through 100 volt to the 1000 volt range sequentially.

POWER SUPPLIES 1 and 2 (See drawing 76-0721)

These two assemblies furnish supply voltages for the instrument. These voltages are +230V, +35V, +25V, +23V, +14V, +1V and -36V. The +230V, +35V, +23V, and -36V supplies are full wave bridge rectified, filtered and unregulated. The +25V, +14V and +1V supplies are full wave rectified, filtered and regulated. Regulation of +25V and +14V is accomplished by circuits which are nearly identical except for component values. Therefore only the +14V regulator will be described.

Regulation is accomplished by passing transistor Q3, which is mounted on the chassis for efficient heat sink operation. The regulated output is compared against the voltage across CR15, amplified by Q1 and fed to the base of Q3. Diodes CR13 and CR14 provide overload protection for the passing transistor Q3. Similarly, diodes CR16 and CR17 provide overload protection for Q1. Current for the zener regulator CR15 is obtained from the regulated +25V supply through R7.

REFERENCE AND RATIO (See drawing 76-0724)

The AC power input to the reference and ratio assembly at pins T1, T2, and T3 is applied directly to voltage reference standard module Z1. The output of Z1 is connected to the range and polarity assembly through pins + and - for polarity selection. The polarity corrected reference voltage is connected back to the reference and ratio assembly at pins B and COM. Potentiometer R4 provides coarse reference voltage adjustment and potentiometer R5 provides fine reference voltage adjustment. Resistors R6 and R7 are selected at the factory to match the individual voltage reference standard module. R6 and R7 narrow the span of coarse and fine calibration adjustment for greater resolution and easier calibration.

The external ratio reference voltages are connected to the reference and ratio assembly at -REF and +REF. The range and polarity assembly -AMP logic output is connected to the reference and ratio assembly at -AMP. The voltage potential at -AMP is common for a positive polarity selection and positive for a negative polarity selection. Common at -AMP forward biases CR1, turning off Q1. The normally closed contacts of K1 connect to +REF. A positive voltage potential at -AMP reverse biases CR1, turning on Q1. K1 closes, connecting to -REF.

When the FUNCTION switch is positioned to any position other than DC RATIO, K2 is not activated. The normally closed contacts connect the internal reference voltage to pin A which is connected to the potentiometer assemblies. When the FUNCTION switch is positioned to DC RATIO, common is provided through CR4 to activate K2. The normally open contacts close and connect the external reference voltage to pin A.

CAUTION

If, for any reason, service on the reference and ratio assembly appears necessary, return the assembly to the factory for correction. Only the coarse and fine adjustments should be handled during routine maintenance. No

other changes or adjustments to the reference and ratio assembly should be attempted. If this caution is not observed, damage to the reference and ratio assembly may result.

PRINT CONTROL - MODEL 7650 ONLY (See drawing 76-0723)

The print control assembly receives negative up drive pulses, negative down drive pulses, and gate pulses from the logic driver assembly. When the PRINT MODE switch is positioned to AUTO and the drive pulses cease (multimeter at null) the print control assembly grounds the gate pulses to common and provides a contact closure for a print command. The grounded gate provides a hold on the multimeter to allow the print cycle to be completed. When the PRINT MODE switch is positioned to HOLD, the gate pulses are grounded to common through the switch contacts. When the PRINT MODE switch is positioned to TRACK, the gate is disconnected from the print control assembly. The collector of Q5, shown on schematic 76-0723, is grounded to common by the switch contacts through CR6, placing a hold on the print control assembly. The front panel PRINT switch is a contact closure which controls K1 to give a print command without regard to the null conditions.

Assume that the PRINT MODE switch is positioned to AUTO. Q1, shown on schematic 76-0723, is turned on by a positive voltage at the base through R2. Q2 is turned off by common at the base from the collector of Q1 through R4. If the charge across C1 is allowed to reach the trigger level of unijunction transistor Q3, the unijunction triggers. Each negative drive pulse from the logic driver assembly turns off Q1, which turns on Q2 and provides a discharge path for C1. In this manner the drive pulses do not allow the charge across C1 to reach the trigger level of Q3. Q4 and Q5 form a bistable multivibrator. Q4 is turned on by a positive voltage at the base through R14 and R17. Q6 is turned on by a positive voltage at the base through R18, allowing C4 to charge positive through R19 and CR14. Q7 is turned on by a positive voltage at the base through R20 and CR12. Q8 is turned off by common at the base from the collector of Q7 through R23.

When the drive pulses cease, Q1 turns on and Q2 turns off. Capacitor C1 charges positive across R7, R8, and R9. Unijunction transistor Q3 fires each time the charge across C1 reaches the trigger level of the unijunction transistor. The charge time of C1 is changed by varying R8. When Q3 fires, a positive pulse is applied to the base of Q5 through C2 and CR9. The bistable multivibrator changes state, Q5 turns on and Q4 turns off. The negative pulse at the collector of Q5 back biases CR12 through CR11 and C3. Q7 is turned off by a negative voltage at the base through R21. Q8 is turned on by a positive voltage at the base through R22 and R23. Q8 grounds the gate to common, placing a hold on the multimeter. Q6 is turned off by common through Q5 and CR8. The collector of Q5 also provides a discharge path for C4 across K2 and CR11. C4 discharges, closing K2 for a print command. Upon completion of the discharge of C4, K2 is released. When C3 charges to the threshold point of CR12, CR12 becomes forward biased and Q6 turns on. Q8 is turned off by common through Q7 and R23, releasing the gate of the multimeter. When drive pulses again turn off Q1, Q2 turns on providing common to the base of Q5 through CR4 and R12. The bistable multivibrator resets.

PRINT OUTPUT- (See drawings 76-0707, 76-0708, 76-0709, and 76-0710)
MODEL 7650 ONLY

The print output assemblies provide isolated print output contact closures in a 10-line decimal code. BCD print output is available on request. The print output assemblies consist of four printed circuit boards, print output A is shown in schematic 76-0708, print output B is shown in schematic 76-0709, print output C is shown in schematic 76-0710, and print output D is shown in schematic 76-0707. The data relayed to the printer includes the front panel indication, decimal point location, function, polarity, and a print command.

DETAIL LOGIC

An important troubleshooting aid in these instruments is a thorough knowledge of the logic, that is, the sequence followed in going from any one reading to any other. Large input changes nearly always cause all three drive systems, UP, FAST-UP, and DOWN, to operate. However, an assumed uninterrupted series of pulses from a single drive at a time is simpler to explain. The explanation is followed by examples.

UP DRIVE ONLY

Assume an initial reading of 0.0000, and an input voltage of 1000V. Beginning with the units (rightmost) each decade will count to 9, then on the next pulse, hold 9 count but advance to S9 (shift 9) condition until a reading of 9.9999 is reached. The next pulse fires the up-range one-shot which drives the range to 99.999. The next pulse advances the range to 999.99. At regular intervals, the range will alternate between the 100 and 1000 volt scales, indicating an input voltage in excess of the capabilities of the instrument.

FAST-UP DRIVE WITH UP DRIVE

For large increases in signal, the fast-up also drives at the same time as the normal up drives. In this instance, the normal counting is shortened by a direct setting of 9 in the units, then a second pulse sets S9. In the same way, the tens and hundreds decades are also advanced to S9 for a total of 6 pulses rather than 30. If the panel sensitivity control is used to reduce sensitivity, the fast-up is lost because of dynamic range limitations. In the examples, the fast-up can be ignored, as the logic remains the same without it, except for total number of pulses.

DOWN DRIVE ONLY

The down drive logic is more complicated than the up system, since the exact order of changing depends upon the range and reading.

The basic sequence of operation is this: first clear to zero any decade in an S9 state, starting with the most significant. Then, after no decade is in an S9 condition, clear each decade to zero starting with the least significant. To illustrate the first operation, assume a reading of +5.8(S9)(S9)(S9).

The order is:

+5.80(S9)(S9)
+5.800(S9)
+5.8000
+5.0000
+0.0000

To illustrate the second operation, assume a reading of +5.8321:

+5.8320
+5.8300
+5.8000
+5.0000
+0.0000

At a reading of 0.0000, the next pulse reverses polarity. Tables V and VI show step-by-step counting logic for different input conditions.

A special case occurs when the range is at 100 or 1000 volts. For this condition, the ten-thousands decade clears to 1 instead of zero. The other decades are cleared in the normal manner. At a reading of 10.000 or 100.00, the next pulse drops the range to 10 volts for a reading of 1.0000. The next pulse clears the 1 to 0 for a reading of 0.0000. This is followed by the polarity reversals. The reason for this seemingly odd logic is the necessity for generating a down-range signal. As described in the paragraph RANGE AND POLARITY, a down-range signal is generated when the units through 1K decades register a count of 0 and the 10K decade registers a count of 1. Thus, any input less than 100 volts is approached from the most sensitive scale and best resolution is obtained.

Table V. Counting Logic With Polarity Change.

NUMERICAL DIRECTION	READOUT	NUMBER OF PULSES
INPUT	-234.05, then reverse polarity to +234.05	
DOWN	-234.00	1
DOWN	-230.00	1
DOWN	-200.00	1
DOWN	-100.00	1
DOWN	-1.0000	1
DOWN	-0.0000	1
DOWN	-0.0000	1
UP	-0.000(S9)	2 with UP and F-UP
UP	-0.00(S9)(S9)	2 with UP and F-UP
UP	-0.0(S9)(S9)(S9)	2 with UP and F-UP
UP	-0.(S9)(S9)(S9)(S9)	10
UP	+(S9).(S9)(S9)(S9)(S9)	10
UP	+(S9)(S9).(S9)(S9)(S9)	1
UP-RANGE One-Shot delays approximately 20 pulses with Filter OUT (100 pulses with Filter IN).		
UP	+(S9)(S9)(S9).(S9)(S9)	1
DOWN	+1(S9)(S9).(S9)(S9)	1
UP	+2(S9)(S9).(S9)(S9)	1
DOWN	+20(S9).(S9)(S9)	1
UP	+23(S9).(S9)(S9)	3
DOWN	+230.(S9)(S9)	1
UP	+234.(S9)(S9)	4
DOWN	+234.0(S9)	1
DOWN	+234.00	1
UP	+234.05	5 and null

Note: (S9) indicates that the 9 displayed is in the shift condition.

Table VI. Counting Logic for Small Voltage Change.

NUMERICAL DIRECTION	READOUT	NUMBER OF PULSES
INPUT	+2.3456 changing to +2.5432	
UP	+2.345(S9)	2 with UP and F-UP
UP	+2.34(S9)(S9)	2 with UP and F-UP
UP	+2.3(S9)(S9)(S9)	2 with UP and F-UP
UP	+2.5(S9)(S9)(S9)	2
DOWN	+2.50(S9)(S9)	1
UP	+2.54(S9)(S9)	4
DOWN	+2.540(S9)	1
UP	+2.543(S9)	3
DOWN	+2.5430	1
UP	+2.5432	2 and null

Note: (S9) indicates that the 9 displayed is in the shift condition.

SECTION VI

MAINTENANCE

GENERAL MAINTENANCE INFORMATION

Troubleshooting the multimeter is extremely simple. Since the majority of components in the multimeter are mounted on plug-in printed circuit board assemblies, troubleshooting is reduced to systematically replacing existing assemblies with spare assemblies until the defect is remedied. Down time is reduced to a very few minutes. Faulty assemblies can be repaired or returned to Cimron or a Cimron representative for repair. Before troubleshooting the multimeter, a thorough study of the theory of operation is recommended.

A parts list of all replaceable parts, an illustrated component location figure, and a schematic of each assembly, are provided. The information for each assembly is contained on consecutive pages.

Each assembly is inserted into an associated slot on the chassis. The assembly and the associated slot have corresponding numbers. The number appears on the rail adjacent to the slot and on the assembly. As an aid in mating an assembly with the slot, the number on the rail is matched with the number on the assembly.

Standard electronic parts used in the multimeter may be obtained locally. It is recommended, however, that precision components and mechanical parts be ordered from a Cimron representative or direct from the factory.

When replacing components on an assembly, care should be taken to prevent damage to the board from excessive heat. A low wattage soldering iron is recommended for soldering operations on the assembly. Whenever practicable, a heat sink should be used between the soldering point and the transistor body.

TROUBLESHOOTING

The optimum voltage values necessary for proper operation are listed on all applicable schematics. The schematics are placed in the manual in a logical sequence of trouble isolation. Failure to obtain the required voltage values at an indicated point indicates which assembly is defective. Replacement of the faulty assembly or assemblies restores the multimeter to proper operation. Replacement of the attenuator and pre-amp assembly, amplifier assembly, logic driver assembly, or reference and ratio assembly requires complete recalibration of the instrument. The procedure for calibration is outlined in Section IV of this manual. When any of the plug-in accessories are replaced the new accessory should be calibrated as described in Section VIII.

CIMRON

PARTS LIST

ASSEMBLY: Attenuator and Preamplifier — CIMRON PART NO. 76-6016

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1601, C1602	5.14 nf	POLY	200V 1%	12406	PD2A5141F	1-57346
C1603	0.01 uf	POLY	200V 1%	12406	PD2A103F	1-57338
C1604, C1605	0.1 uf	MET PAP	50V 10%	12406	VX5A104K	1-57321
C1606	15 nf	POLY	200V 20%	12406	PD2362	1-57310
C1607 - C1609	2.2 nf	GLASS	500V 10%	07115	CYFM20C222K	1-57601
C1610	560 pf	GLASS	500V 10%	07115	CYFM20C561K	1-57600
C1611	15 nf	POLY	200V 20%	12406	PD2362	1-57310
C1612	22 pf	SIL MICA	500V 5%	04062	CM-15-C-220J	1-57463
C1613	1 uf	MET PAP	50V 10%	12406	VX5A105K	1-57317
C1614	100 uf	ELECT	25V	14655	NLW 100-25	1-57253
C1615	1 uf	MET PAP	50V 10%	12406	VX5A105K	1-57317
C1616, C1617	0.1 uf	POLY	200V 20%	12406	PD2363	1-57309
C1618	560 pf	CER DISC		71590	DD-561	1-57500
RESISTOR						
R1601***	10 MΩ	MET FILM	2W 0.25%	07716	MEH-T9	7-46121
R1602	560 KΩ	COMP	2W 5%	01121	HB-5645	7-45076

CIMRON

PARTS LIST

ASSEMBLY: Attenuator and Preamplifier — CIMRON PART NO. 76-6016

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1603***	100.75 KΩ	COMP WW	0.05%	07088	OB	7-47200
R1604	500Ω	VAR TRIM WW		97704	1PC-500Ω	7-54240
R1605 ***	1 MΩ	MET FILM	1/2W 0.25%	07716	MEC-T9	7-46120
R1606 ***	105 KΩ	MET FILM	1/2W 0.25%	07716	MEC-T9	7-46135
R1607	10 KΩ	VAR TRIM WW		80294	275-1-103	7-54103
R1608	523 KΩ	DEP CARB	1/8W 1%	07716	RN-60B	7-46522
R1609	255 KΩ	MET FILM	1/8W 1%	07716	MEA	7-46139
R1610	523 KΩ	DEP CARB	1/8W 1%	07716	RN-60B	7-46522
R1611	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1612	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1613	3.32 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46504
R1614	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1615	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R1616	475 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46505
R1617	5.6 KΩ	COMP	1/2W 5%	01121	CB-5625	7-41052
R1618	2.74 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46503
R1619	3.32 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46504

CIMRON

PARTS LIST

ASSEMBLY: Attenuator and Preamplifier CIMRON PART NO. 76-6016

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1620	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
R1621	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R1622	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
R1623	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
Resistor Kit***						5-40021
SEMICONDUCTOR						
CR1601		*CD-61 DIODE		15318		7-95511
CR1602		**CD-62 DIODE		15318		7-95507
CR1603		*CD-61 DIODE		15318		7-95511
CR1604		**CD-62 DIODE		15318		7-95507
CR1605		*CD-61 DIODE		15318		7-95511
CR1606		**CD-62 DIODE		15318		7-95507
CR1607		*CD-61 DIODE		15318		7-95511
CR1608, CR1609		DIODE		72314	FD-300	7-95505
CR1610, CR1611		*CD-61 DIODE		15318		7-95511
CR1612, CR1613		ZENER DIODE		JEDEC	1N712	7-95611

CIMRON

PARTS LIST

ASSEMBLY: Attenuator and Preamplifier — CIMRON PART NO. 76-6016

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
TRANSISTOR						
Q1601, Q1602		CT-26 or 2N2222		15318		9-04710
Q1603				JEDEC	2N3567	9-04719
MISCELLANEOUS						
T1601		TRANSFORMER		84171	TT-039	9-01003
G1601		CHOPPER		15318		70-0505-1
L1601 - L1604		REED COIL		15318		70-0501-1
S1601		RELAY REED SPST		12617	DRG-1	7-38208
S1602 - S1604		RELAY REED SPST		12617	DRG-5	7-38211
VR1601, VR1602		NEON LAMP		15318	NE-68	5-46503
		CHOPPER BKT		15318		70-2005-1
		CHOPPER SOCKET	4 PIN	72825	9721-194	8-24110
		SHIELD ASSEMBLY		15318		70-2004-1
		ETCHED CIRCUIT BOARD		15318		76-7016

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

**CD-62, I_f = 1V greater than 100 ma, I_r = 300V less than 1 ua, SILICON

***Either R1601. R1603, R1605, and R1606 or a resistor kit may be used.

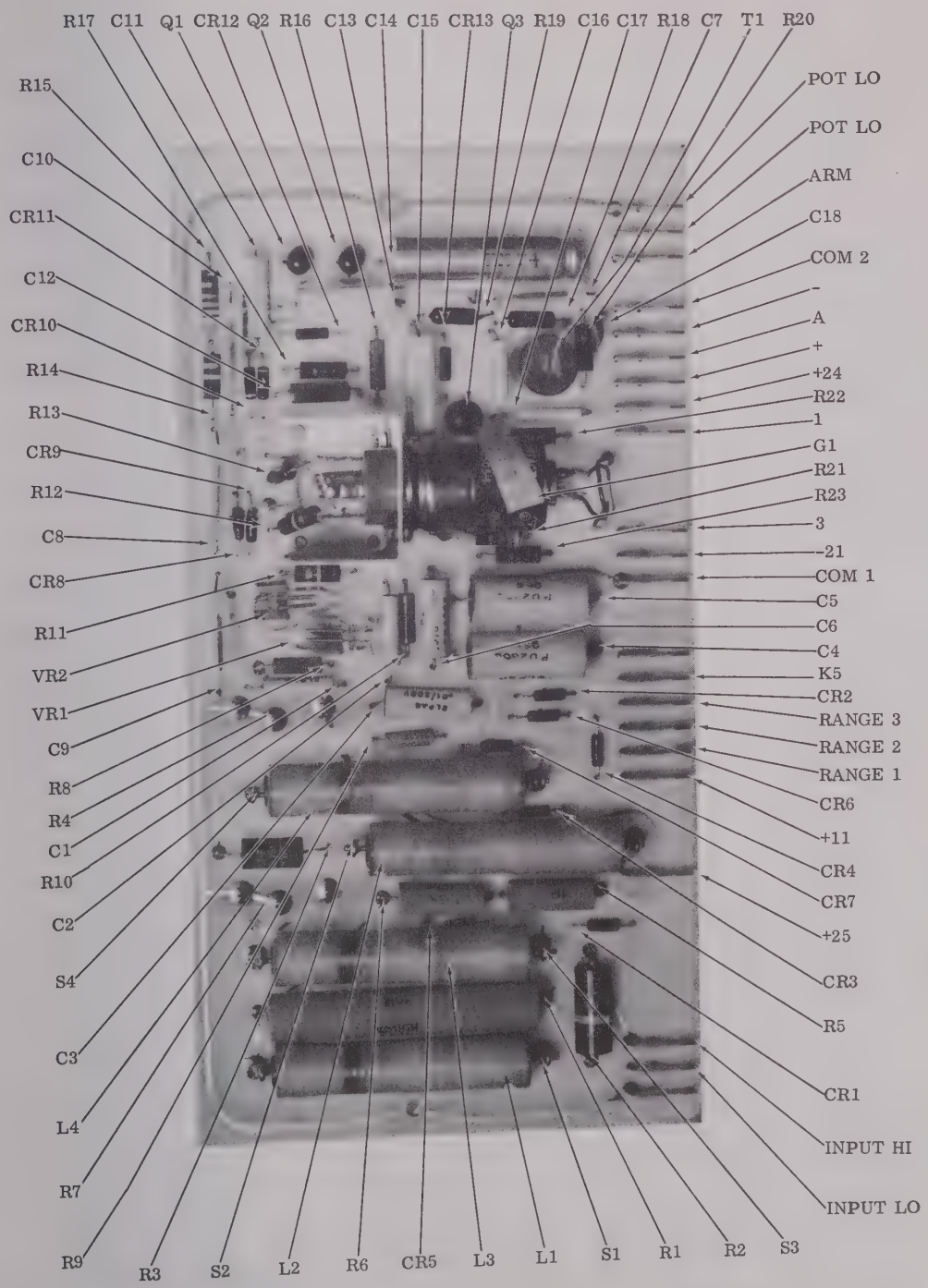
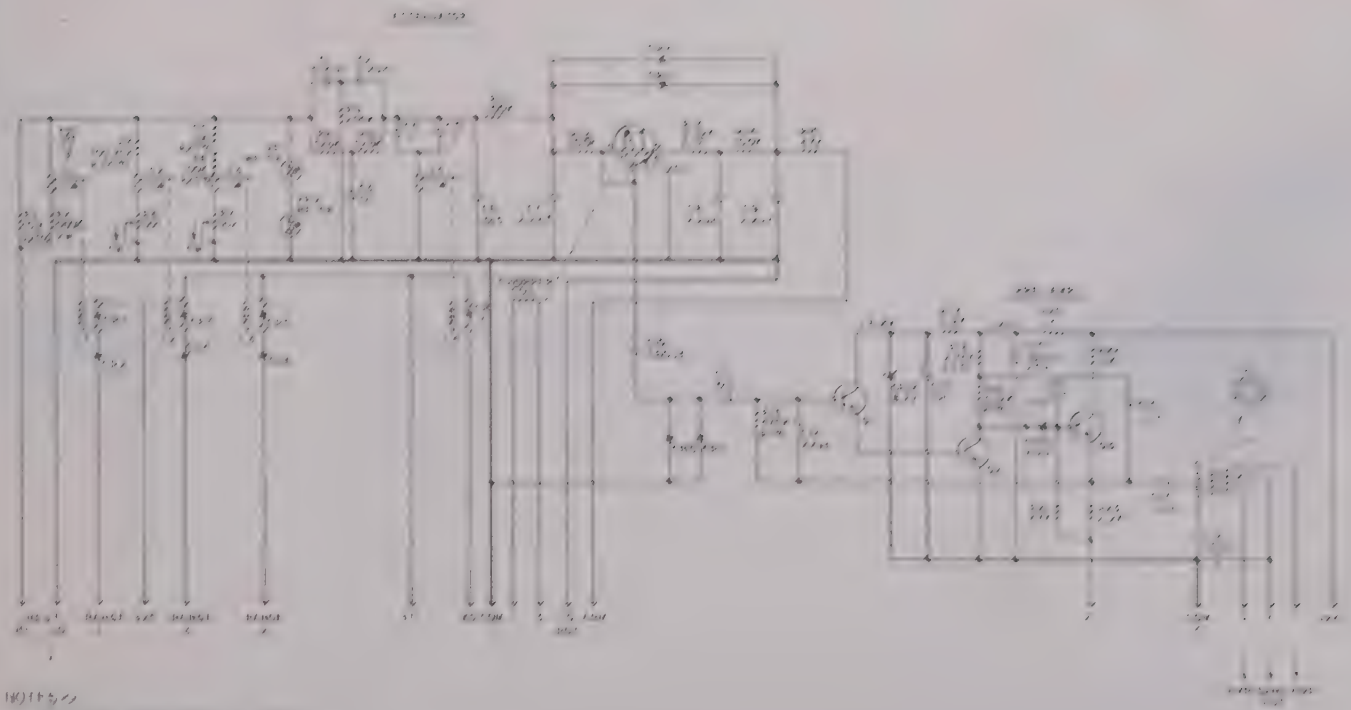


Figure 6-1. Attenuator and Pre-Amp Assembly.



CIMRON

PARTS LIST

ASSEMBLY: Amplifier — CIMRON PART NO. 76-6013

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1302	0.47 uf	MET PAP	50V 10%	12406	VX5A474K	1-57318
C1303	1.8 nf	CER DISC	10%	71590	DD-182	1-57503
C1304	0.1 uf	MET PAP	50V 10%	12406	VX5A104K	1-57321
C1305	22 nf	MET PAP	50V 10%	12406	VX5A223K	1-57326
C1306	0.1 uf	MET PAP	50V 10%	12406	VX5A104K	1-57321
C1307	22 pf	SILVER MICA	5%	04062	CM-15-C-220J	1-57463
C1308	22 nf	MET PAP	50V 10%	12406	VX5A223K	1-57326
C1309	0.47 uf	MET PAP	50V 10%	12406	VX5A474K	1-57318
C1310	20 uf	ELECT	50V	14655	NLW 20-50	1-57256
C1311	0.22 uf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C1312	2.2 nf	MET MY	10%	14752	215BIC222K2	1-57351
C1313	0.01 uf	MET PAP	50V 10%	12406	VX5A103K	1-57323
C1315	1 uf	MET PAP	50V 10%	12406	VX5A105K	1-57317
C1316	0.22 uf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C1317 - C1319	1.8 nf	CER DISC	10%	71590	DD-182	1-57503
C1320	1 uf	MET PAP	50V 10%	12406	VX5A105K	1-57317

CIMRON

PARTS LIST

ASSEMBLY: Amplifier — CIMRON PART NO. 76-6013

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1301	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1302	56 KΩ	COMP	1/2W 5%	01121	EB-5635	7-41064
R1303	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1304	56 KΩ	COMP	1/2W 5%	01121	EB-5635	7-41064
R1308, R1309	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1310	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1311	10 KΩ	VAR TRIM WW	10%	80294	275-1-103	7-54103
R1312	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1313	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1314	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1315	4.75 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46500
R1316 - R1318	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1319	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R1320	33 KΩ	COMP	1/2W 5%	01121	EB-3335	7-41061
R1321	47.5 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46502
R1322	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1323	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059

CIMRON

PARTS LIST

ASSEMBLY: Amplifier — CIMRON PART NO. 76-6013

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1324	6.8 KΩ	COMP	1/2W 5%	01121	EB-6825	7-41053
R1325 - R1327	33 KΩ	COMP	1/2W 5%	01121	EB-3335	7-41061
R1328	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1329	680Ω	COMP	1/2W 5%	01121	EB-6815	7-41041
R1330	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1331	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1332	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
R1333	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1334	470Ω	COMP	1/2W 5%	01121	EB-4715	7-41039
R1335	220Ω	COMP	1/2W 5%	01121	EB-2215	7-41035
R1336, R1337	10 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46501
R1338	56Ω	COMP	1/2W 5%	01121	EB-5605	7-41028
R1339	2 KΩ	VAR TRIM WW	10%	80294	275-1-202	7-54202
R1340	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1341	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1342	47.5 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46502
R1343	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055

CIMRON

PARTS LIST

ASSEMBLY: Amplifier — CIMRON PART NO. 76-6013

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR						
R1345	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R1346, R1347	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1348, R1349	680Ω	COMP	1/2W 5%	01121	EB-6815	7-41041
R1350	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1351, R1352	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1353, R1354	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1355	120Ω	COMP	1/2W 5%	01121	EB-1215	7-41032
R1356	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
RT1301	20 KΩ	THERM	25°C	79094	1D051	7-48502
SEMICONDUCTOR						
CR1301 - CR1308		*CD-62 SIL TYPE DIODE		15318		7-95507
CR1310 - CR1313		**CD-61 DIODE		15318		7-95511
CR1314				JEDEC	1N750	7-95608
CR1315				JEDEC	1N722	7-95612
TRANSISTOR						
Q1301, Q1302				JEDEC	2N1304	9-04500

CIMRON

PARTS LIST

ASSEMBLY: Amplifier — CIMRON PART NO. 76-6013

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
TRANSISTOR						
Q1304		CT-20 or 2N697		15318		9-04701
Q1305, Q1306		CT-26 or 2N2222		15318		9-04710
Q1307		CT-20 or 2N697		15318		9-04701
Q1308 - Q1310				JEDEC	2N404A	9-04609
Q1311 - Q1313		CT-20 or 2N697		15318		9-04701
Q1314				JEDEC	2N1183B	9-04605
Q1315, Q1316				JEDEC	2N1304	9-04500
MISCELLANEOUS						
T1301		TRANSFORMER PRINTED CIRCUIT		84171	TT-039	9-01003
		ETCHED CIRCUIT BOARD		15318		76-7013-1
		SHIELD ASSEMBLY		15318		76-2006-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

*CD-62, I_f = 1V greater than 100 ma, I_r = 300V less than 6 ua, SILICON

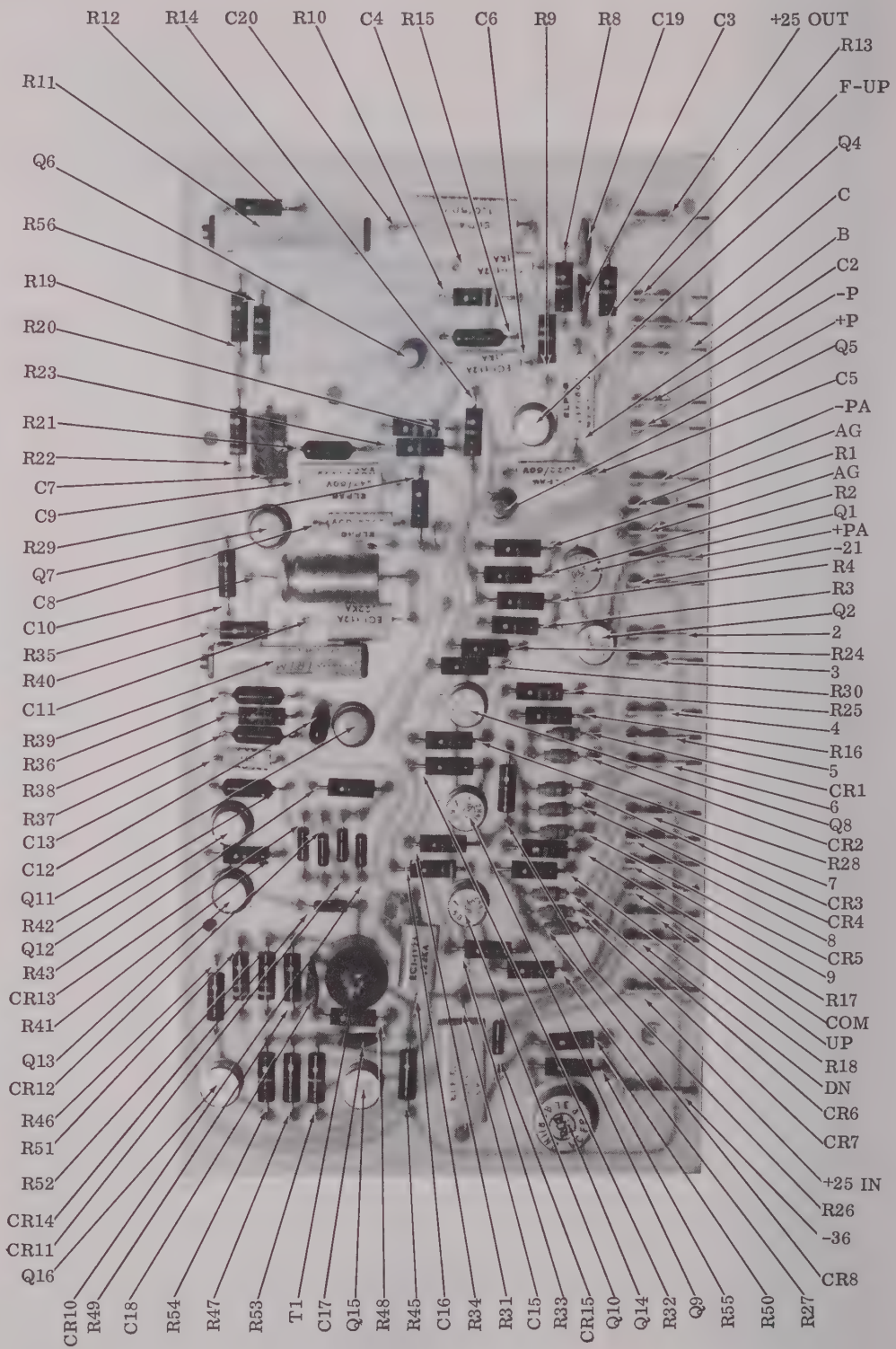
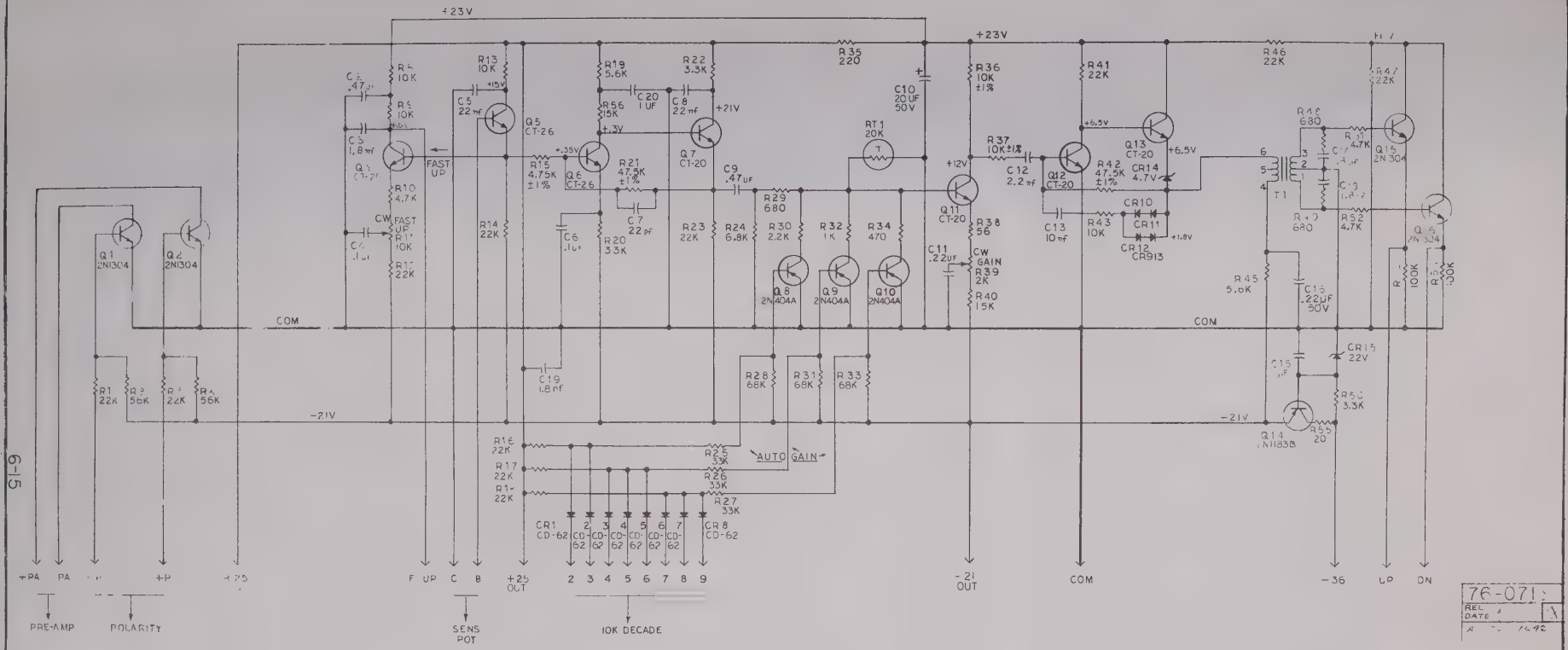


Figure 6-2. Amplifier Assembly.



6-15

76-071 REL DATE J A 1472 1

NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE ½ WATT & ±5% TOLERANCE.
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 1[illegible]. EXAMPLE R1 IS R[illegible].

D SCHEMATIC — 76-6013 AMPLIFIER ASSY

CIMRON

76-0713 REV A

7600 SERIES DRAFT WJB DATE CHF ENG PROJECT APPD DATE SCALE NONE SHEET 1 OF 1

CIMRON

PARTS LIST

ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1201	0.1 uf	PAP	50V	12406	VX5A104K	1-57321
C1202	22 nf	PAP	50V	12406	VX5A223K	1-57326
C1203	2.2 uf	TANT	35V	01295	SCM225BP035D4	1-57104
C1204	560 pf	CER DISC	1000V	71590	DD-561	1-57500
C1205	50 uf	ELECT	50V	14655	NLW 50-50	1-57257
C1206	1 nf	CER DISC	1000V	71590	DD-102	1-57504
C1207	4.7 nf	PAP	50V	12406	VX5A472K	1-57331
C1208	22 nf	PAP	50V	12406	VX5A223K	1-57326
C1209	50 uf	ELECT	50V	14655	NLW 50-50	1-57257
C1210	0.22 uf	PAP	50V	12406	VX5A224K	1-57319
C1211 - C1213	560 pf	CER DISC	1000V	71590	DD-561	1-57500
C1214	1 uf	PAP	50V	12406	VX5A105K	1-57317
C1215	1 uf	PAP	50V	12406	VX5A105K	1-57317
C1216	1.8 nf	CER DISC	1000V	71590	DD-182	1-57503
C1217	1 nf	CER DISC	1000V	71590	DD-102	1-57504
C1218	4.7 nf	PAP	50V	12406	VX5A472K	1-57331
C1219, C1220	22 nf	PAP	50V	12406	VX5A223K	1-57326

CIMRON

PARTS LIST

ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
CAPACITOR						
C1221	50 uf	ELECT	50V	14655	NLW 50-50	1-57257
C1222	0.01 uf	PAP	50V	12406	VX5A103K	1-57323
C1223	4.7 nf	PAP	50V	12406	VX5A472K	1-57331
C1224	22 nf	PAP	50V	12406	VX5A223K	1-57326
C1225	0.01 uf	PAP	50V	12406	VX5A103K	1-57323
C1226	15 nf	MET PAP	50V	12406	VX5A153K	1-57329
RESISTOR						
R1201, R1202	12 KΩ	COMP	1/2W 5%	01121	EB-1235	7-41056
R1203	33 KΩ	COMP	1/2W 5%	01121	EB-3335	7-41063
R1204	12 KΩ	COMP	1/2W 5%	01121	EB-1235	7-41056
R1205	56 KΩ	COMP	1/2W 5%	01121	EB-5635	7-41064
R1206	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1207, R1208	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1209	12 KΩ	COMP	1/2W 5%	01121	EB-1235	7-41056
R1210, R1211	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1212, R1213	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1214 - R1216	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1217, R1218	180 KΩ	COMP	1/2W 5%	01121	EB-1845	7-41070
R1219	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067

CIMRON

PARTS LIST

ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1220	330Ω	COMP	1/2W 5%	01121	EB-3315	7-41037
R1221	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1222	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1223	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1224, R1225	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1226	100 Ω	DEP CARB	1/8W 1%	00656	TYPE CPM	7-46507
R1227	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1228	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1229, R1230	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1231	100 Ω	DEP CARB	1/8W 1%	00656	TYPE CPM	7-46507
R1232	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1233	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1234	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1235	6.8 KΩ	COMP	1/2W 5%	01121	EB-6825	7-41053
R1236	470Ω	COMP	1/2W 5%	01121	EB-4715	7-41039
R1237	20 KΩ	WW	1/4W	80294	200P-1-203	7-54203

CIMRON

PARTS LIST

ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1239	47Ω	COMP	1/2W 5%	01121	EB-4705	7-41027
R1240	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R1241	150 KΩ	COMP	1/2W 5%	01121	EB-1545	7-41069
R1242	1 MΩ	COMP	1/2W 5%	01121	EB-1055	7-41079
R1243, R1244	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1245	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1246	680 KΩ	COMP	1/2W 5%	01121	EB-6845	7-41077
R1247, R1248	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1249	220Ω	COMP	1/2W 5%	01121	EB-2215	7-41035
R1250	180Ω	COMP	1/2W 5%	01121	EB-1815	7-41034
R1251, R1252	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1253	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1254	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1255	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1256	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1257, R1258	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1259	200Ω	TRIM POT WW		80294	275-1-201	7-54215

CIMRON

PARTS LIST

ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1220	330Ω	COMP	1/2W 5%	01121	EB-3315	7-41037
R1221	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1222	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1223	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1224, R1225	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1226	100 Ω	DEP CARB	1/8W 1%	00656	TYPE CPM	7-46507
R1227	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1228	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1229, R1230	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1231	100 Ω	DEP CARB	1/8W 1%	00656	TYPE CPM	7-46507
R1232	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1233	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1234	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1235	6.8 KΩ	COMP	1/2W 5%	01121	EB-6825	7-41053
R1236	470Ω	COMP	1/2W 5%	01121	EB-4715	7-41039
R1237	20 KΩ	WW	1/4W	80294	200P-1-203	7-54203

CIMRON

PARTS LIST

ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1239	47Ω	COMP	1/2W 5%	01121	EB-4705	7-41027
R1240	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R1241	150 KΩ	COMP	1/2W 5%	01121	EB-1545	7-41069
R1242	1 MΩ	COMP	1/2W 5%	01121	EB-1055	7-41079
R1243, R1244	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1245	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R1246	680 KΩ	COMP	1/2W 5%	01121	EB-6845	7-41077
R1247, R1248	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1249	220Ω	COMP	1/2W 5%	01121	EB-2215	7-41035
R1250	180Ω	COMP	1/2W 5%	01121	EB-1815	7-41034
R1251, R1252	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1253	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1254	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1255	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1256	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1257, R1258	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1259	200Ω	TRIM POT WW		80294	275-1-201	7-54215

CIMRON

PARTS LIST

ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1260	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1261	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1262	47Ω	COMP	1/2W 5%	01121	EB-4705	7-41027
R1263, R1264	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1265	100Ω	DEP CARB	1/8W 1%	00656	TYPE CPM	7-46507
R1266	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1267	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1268	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1269	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R1270	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1271	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R1272	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1273	6.8 KΩ	COMP	1/2W 5%	01121	EB-6825	7-41053
R1274	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R1275	2.2 KΩ	COMP	1/2W 5%	01121	EB-2225	7-41047
R1276	270Ω	COMP	1/2W 5%	01121	EB-2715	7-41036
R1277	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055

CIMRON

PARTS LIST

ASSEMBLY: Logic-Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1278, R1279	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1280	1.5 KΩ	COMP	1/2W 5%	01121	EB-1525	7-41045
R1281	47Ω	COMP	1/2W 5%	01121	EB-4705	7-41027
R1282	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1283	100Ω	DEP CARB	1/8W 1%	00656	TYPE CPM	7-46507
R1284	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1285	180 KΩ	COMP	1/2W 5%	01121	EB-1845	7-41070
R1286	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1287	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
SEMICONDUCTOR						
CR1201 - CR1210		*CD-61 DIODE		15318		7-95511
CR1211		ZENER DIODE		JEDEC	1N973B	7-95616
CR1212 - CR1220		*CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q1201 - Q1210				JEDEC	2N3567	9-04719
Q1211		UNIJUNCTION		JEDEC	2N2647 or 4JD5E29 or 4JDX5E738	9-04400
Q1212 - Q1221				JEDEC	2N3567	9-04719

CIMRON

PARTS LIST

ASSEMBLY: Logic Driver — CIMRON PART NO. 76-6012

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
MISCELLANEOUS						
L1201		REED COIL		15318		70-0511-1
S1201		REED SWITCH		95348	MR-306-8	7-38216
RT1201	100 KΩ	RESISTOR, THERM ROD	25°C	79094	51R5	7-48500
		ETCHED CIRCUIT BOARD		15318		76-7012-5

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

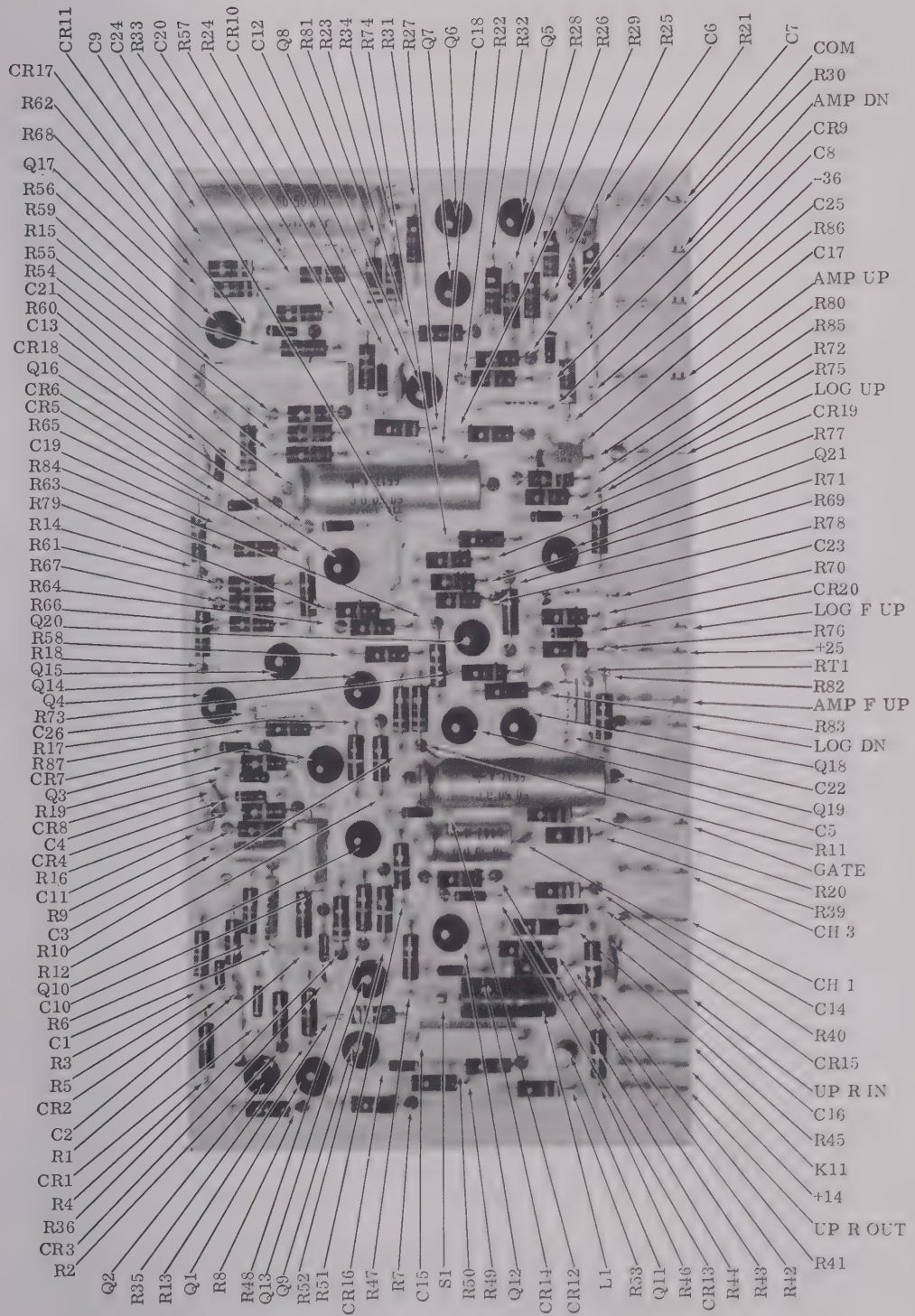
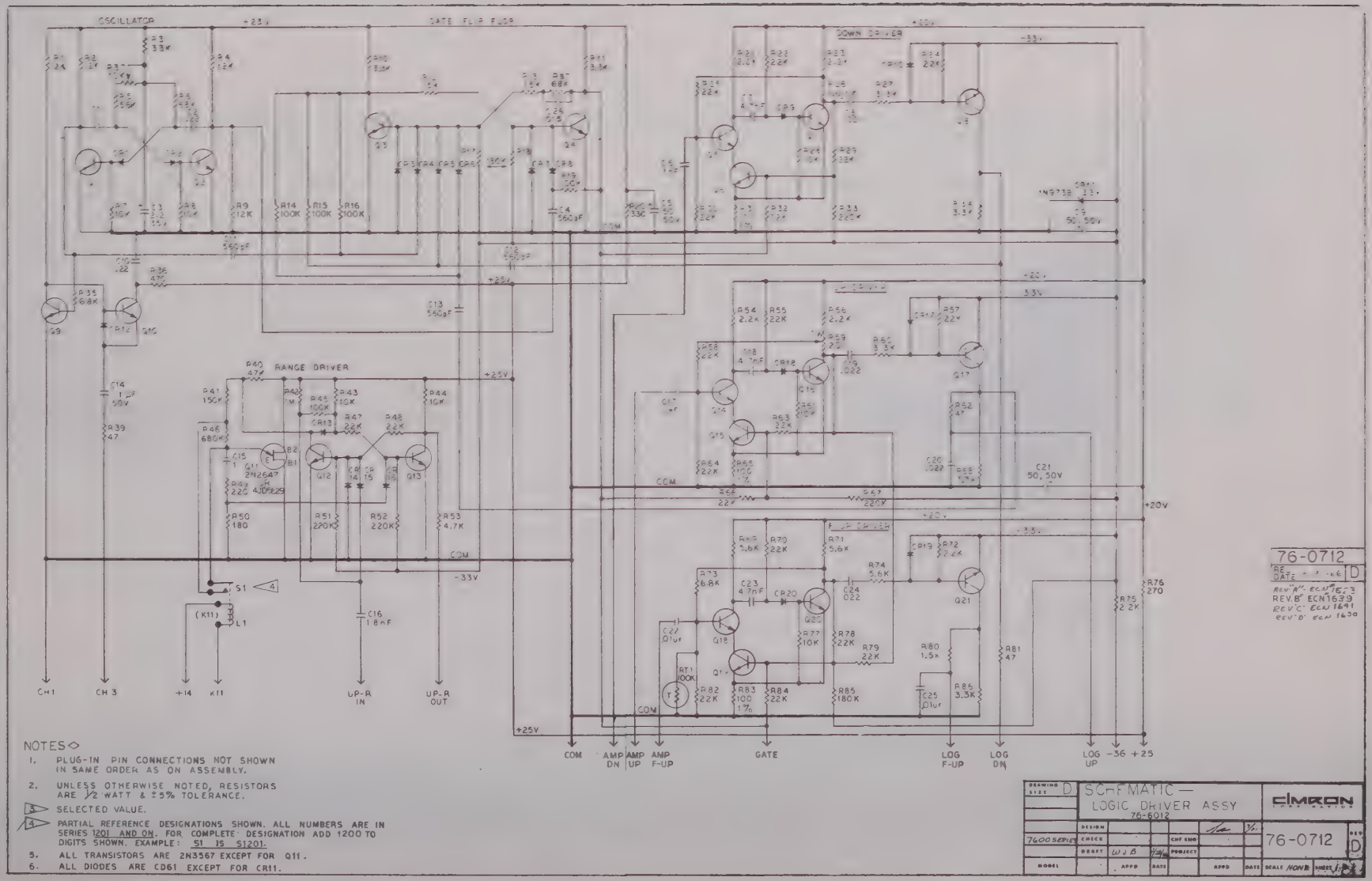


Figure 6-3. Logic Driver Assembly.



NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE ½ WATT & ±5% TOLERANCE.

3 ◇ SELECTED VALUE.

4 ◇ PARTIAL REFERENCE DESIGNATIONS SHOWN. ALL NUMBERS ARE IN SERIES 1201 AND ON. FOR COMPLETE DESIGNATION ADD 1200 TO DIGITS SHOWN. EXAMPLE: S1 IS S1201.

5. ALL TRANSISTORS ARE 2N3567 EXCEPT FOR Q11.
6. ALL DIODES ARE CD61 EXCEPT FOR CR11.

CIMRON

PARTS LIST

ASSEMBLY: Logic Matrix — CIMRON PART NO. 76-6017

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1701 - R1706	2.2 KΩ	COMP	1/4W 5%	01121	CB-2225	7-41247
R1707 - R1711	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1712 - R1721	2.7 KΩ	COMP	1/4W 5%	01121	CB-2725	7-41248
R1722 - R1729	2.2 KΩ	COMP	1/4W 5%	01121	CB-2225	7-41247
SEMICONDUCTOR						
CR1701 - CR1773		*CD-61 DIODE		15318		7-95511
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7017-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

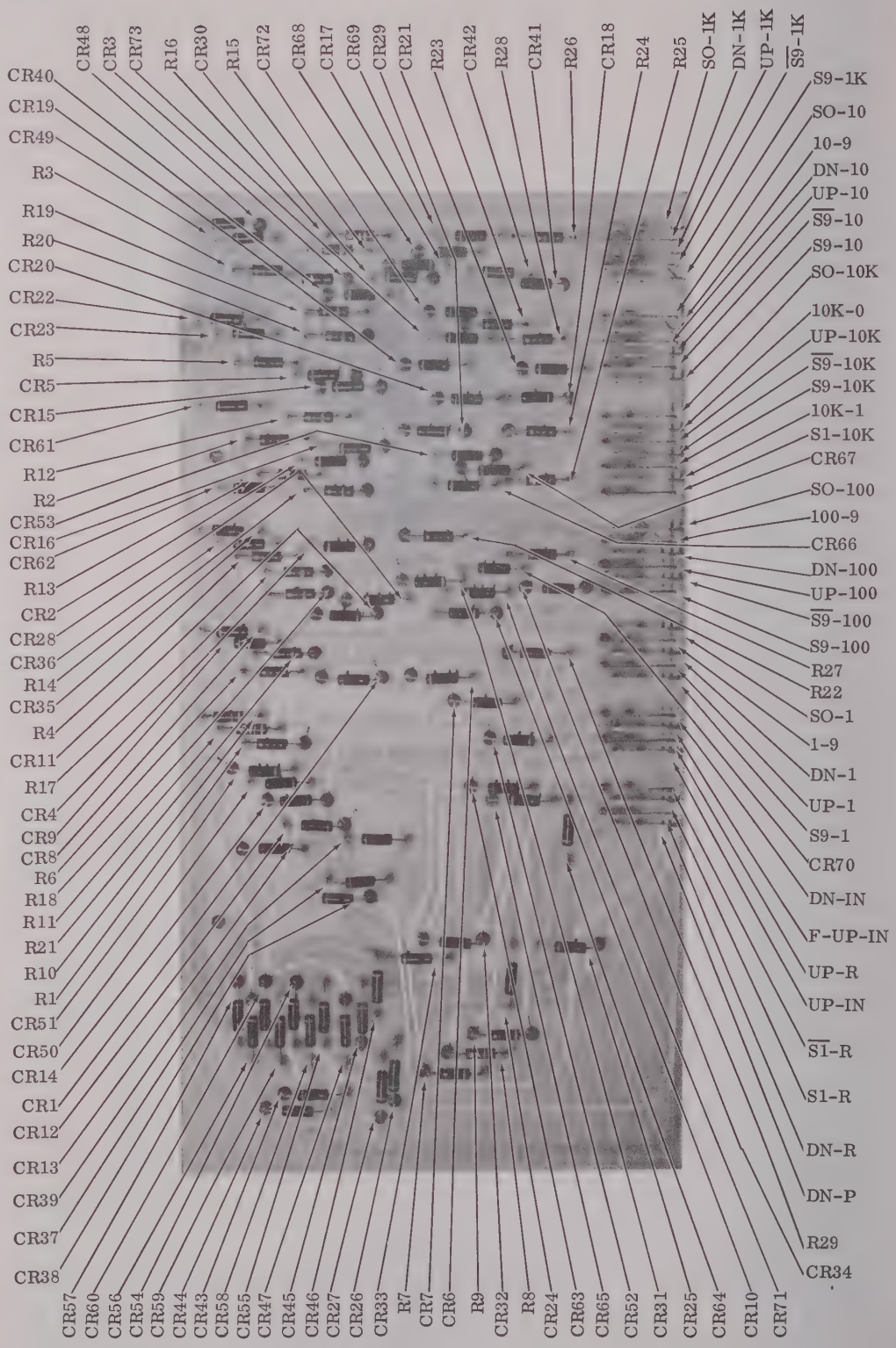
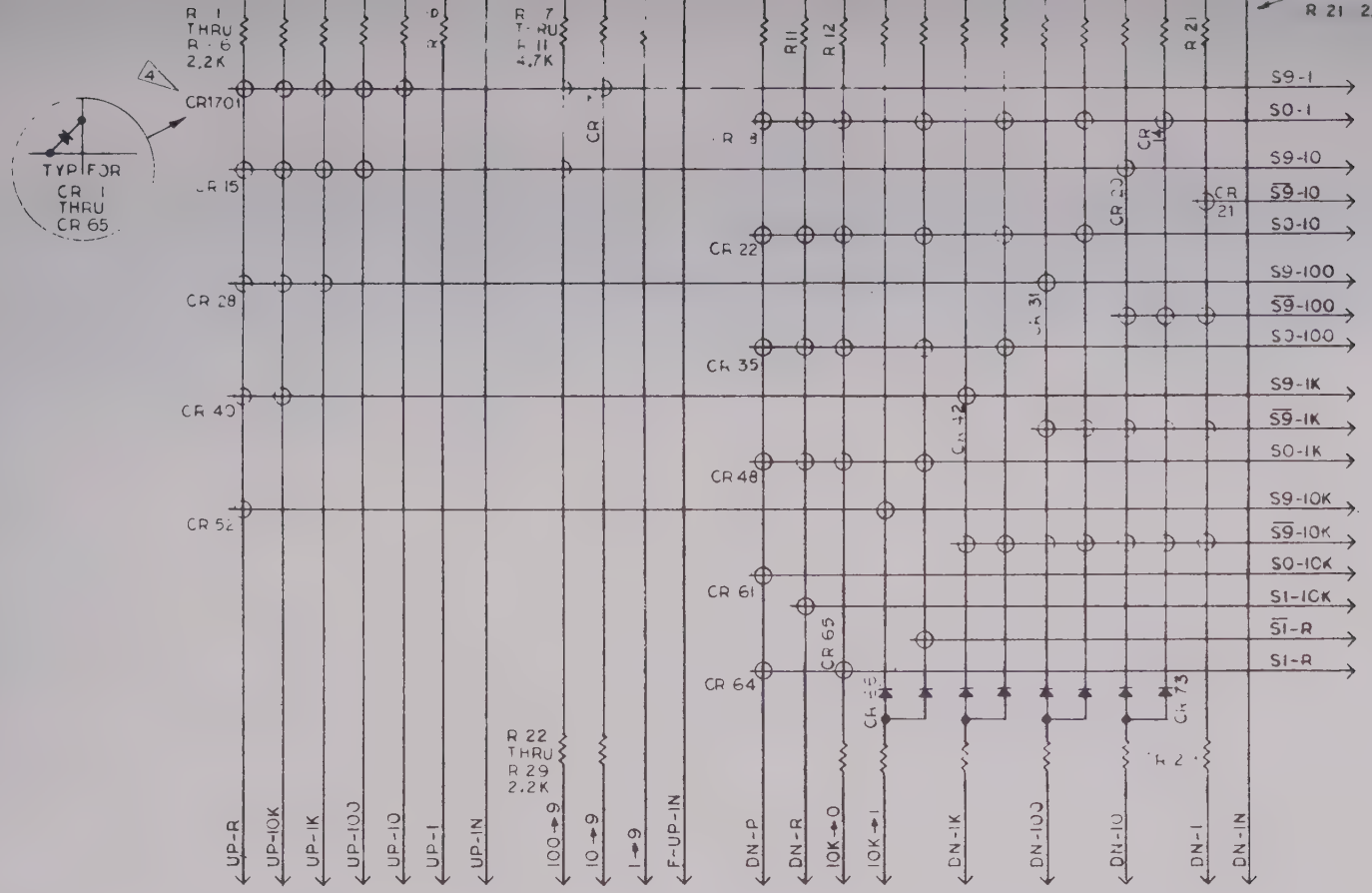


Figure 6-4. Logic Matrix Assembly.



NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. ALL RESISTORS ±5%, 1/4 WATT.
3. ALL DIODES SAME TYPE.

4 > PARTIAL REFERENCE DESIGNATORS USED. ALL DESIGNATORS ARE IN THE SERIES 1701 & ON. FOR COMPLETE DESIGNATOR ADD .1700 TO NUMBER SHOWN. EXAMPLE R1 IS R1701

76-0717
REL
DATE

DRAWING SIZE C	SCHEMATIC — 76-6017 LOGIC MATRIX ASSY							CIMRON INTEGRATION	
	DESIGN							76-0717	REV
	CHECK	[illegible]	12-21-65	CHF ENGR					
7630, 7650	DRAFT	R. KLASNA	12-20-65	PROJECT					
MODEL		APPD	DATE		APPD	DATE	SCALE NONE	SHEET 1 OF 1	

CIMRON

PARTS LIST

ASSEMBLY: Units through 1K Decade — CIMRON PART NO. 76-6018

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1801 - C1805	560 pf	CER DISC		71590	DD-561	1-57500
C1806 - C1809	4.7 nf	MET PAP		12406	VX5A472K	1-57331
C1810	0.47 uf	MET PAP	50V	12406	VX5A474K	1-57318
C1811 - C1815	22 nf	MET PAP		12406	VX5A223K	1-57326
C1816 - C1817	0.22 uf	MET PAP	50V	12406	VX5A224K	1-57319
RESISTOR						
R1801	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1802	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1803	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1805	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1806	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1807	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1808	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1809	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1810	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1811	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1814	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272

CIMRON

PARTS LIST

ASSEMBLY: Units through 1K Decade — CIMRON PART NO. 76-6018

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1815	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1816	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1817	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1818	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1819	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1820	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1823	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1824	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1825	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1826	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1827	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1828	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1829, R1830	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1831	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1832	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1833	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1834	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252

CIMRON

PARTS LIST

ASSEMBLY: Units through 1K Decade — CIMRON PART NO. 76-6018

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1835	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1836, R1837	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1838	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1839	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R1840 - R1842	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1843	220 KΩ	COMP	1/4W 5%	01121	CB-2245	7-41271
R1844 - R1846	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1847 - R1850	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R1851	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1852	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1853	1.5 KΩ	COMP	1/4W 5%	01121	CB-1525	7-41245
R1854 - R1858	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1859	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R1860	82 KΩ	COMP	1/4W 5%	01121	CB-8235	7-41266
R1861	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1862	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1863	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253

CIMRON

PARTS LIST

ASSEMBLY: Units through 1K Decade — CIMRON PART NO. 76-6018

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1864 - R1866	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1867	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1868	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1869	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R1870	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1871, R1872	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1873 - R1882	470 KΩ	COMP	1/4W 5%	01121	CB-4745	7-41275
R1883	330 KΩ	COMP	1/4W 5%	01121	CB-3345	7-41273
R1884	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1885	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
SEMICONDUCTOR						
CR1801 - CR1851		*CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q1801 - Q1810				JEDEC	2N3567	9-04719
Q1811				JEDEC	2N1309	9-04611
Q1812 - Q1821		CT-22 or 2N3114		15318		9-04705

CIMRON

PARTS LIST

ASSEMBLY: Units through 1K Decade — CIMRON PART NO. 76-6018

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
TRANSISTOR						
Q1822 - Q1823				JEDEC	2N3567	9-04719
Q1824 - Q1825				JEDEC	2N1309	9-04611
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7018-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1ua, SILICON

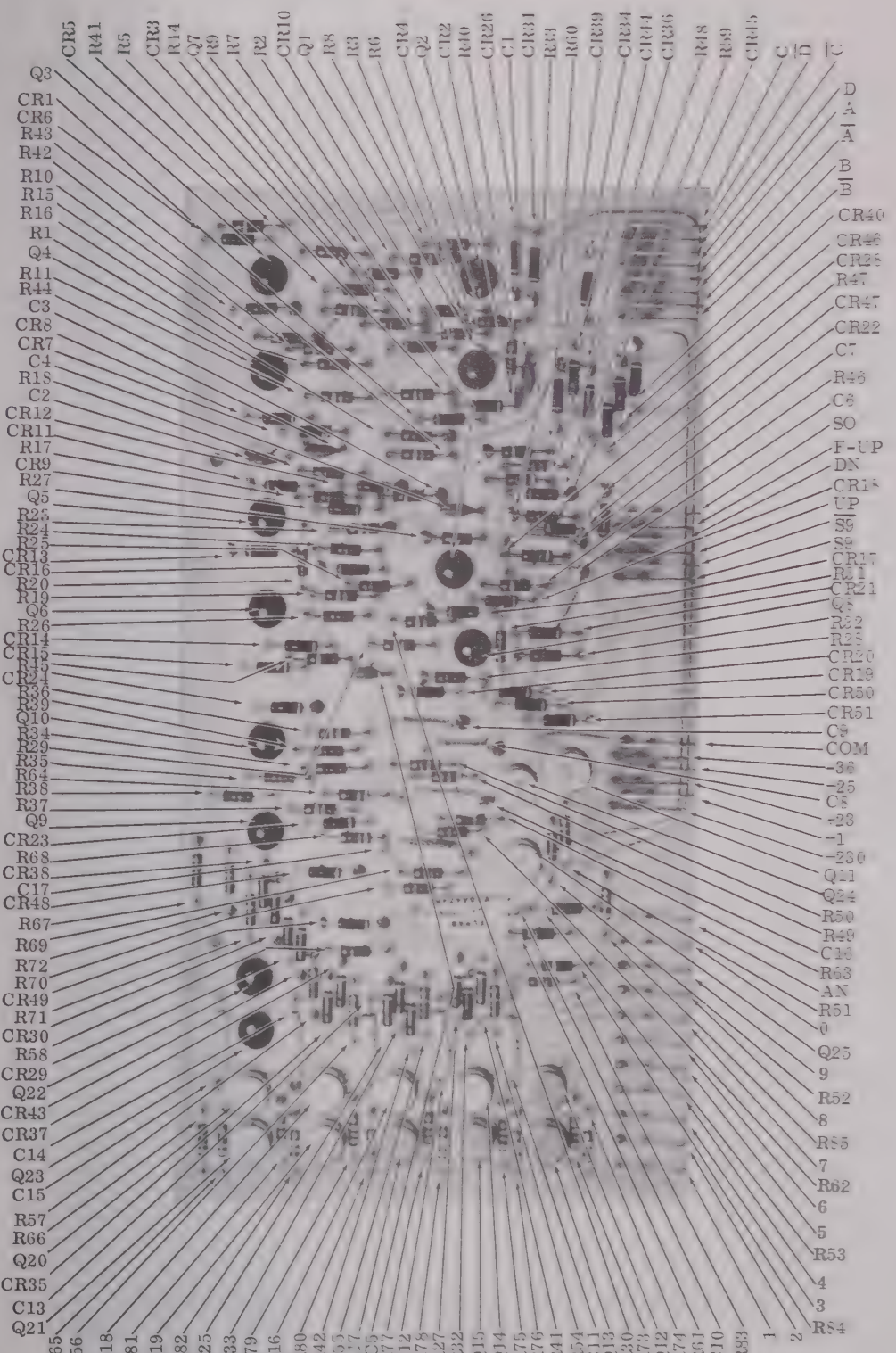
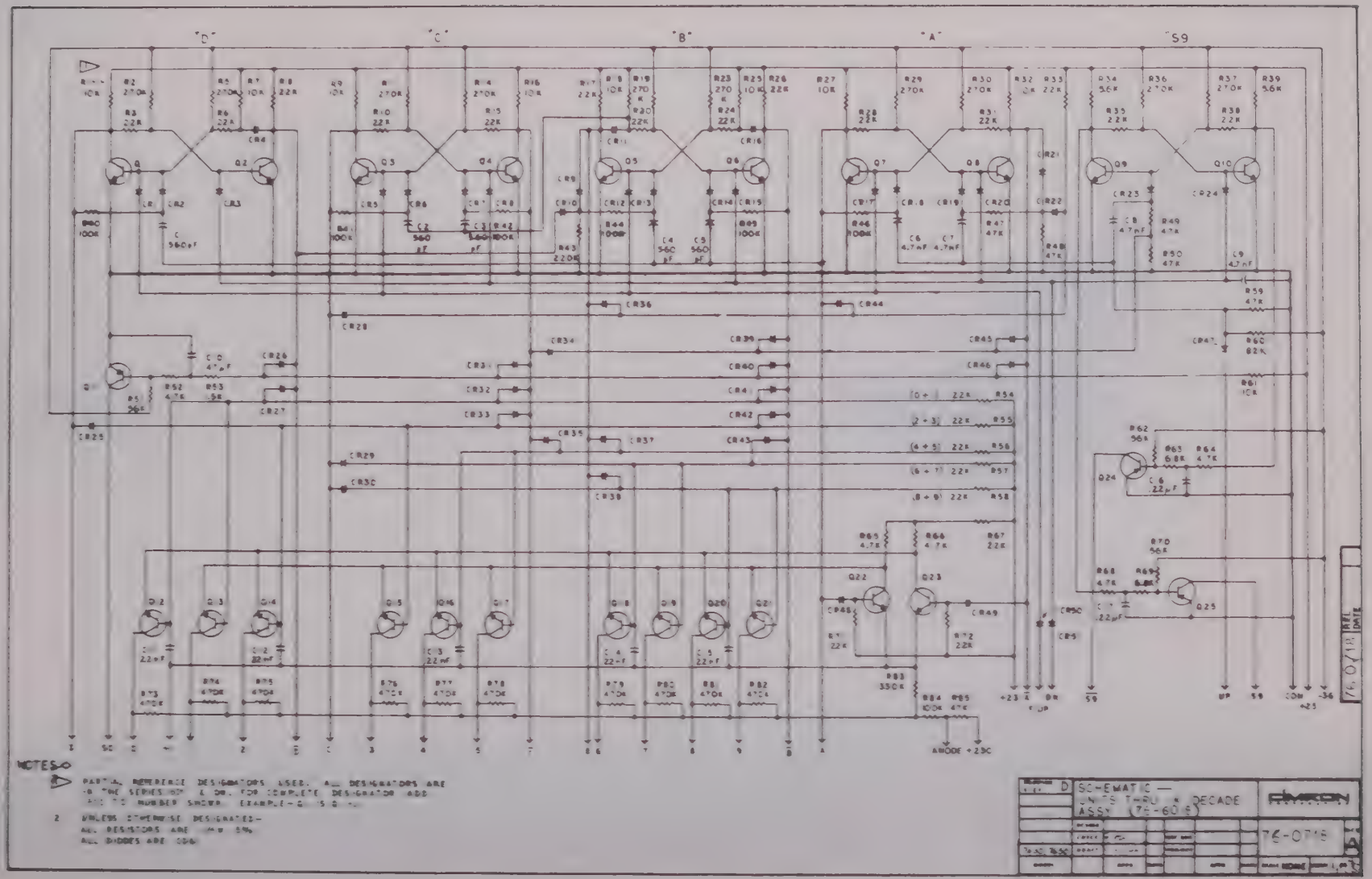


Figure 6-5. Units Through 1K Decade Assembly.


"D"
"C"
"B"
"A"
"S9"
NOTES:
1 PARTIAL REFERENCE DESIGNATORS USED. ALL DESIGNATORS ARE IN THE SERIES 100 & 200. FOR COMPLETE DESIGNATOR ADD THE NUMBER SHOWN. EXAMPLE - C1 IS C101.
2 UNLESS OTHERWISE DESIGNATED -
ALL RESISTORS ARE ¼W 5%
ALL DIODES ARE 1N4148
SCHEMATIC — UNITS THRU 9 DECADE ASSY (76-60 S)
76-0716
ANODE +23C

CIMRON

PARTS LIST

ASSEMBLY: 10K Decade — CIMRON PART NO. 76-6011

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1101 - C1105	560 pf	CER DISC		71590	DD-561	1-57500
C1106 - C1110	4.7 nf	PAP		12406	VX5A472K	1-57331
C1111 - C1112	0.47 uf	PAP	50V	12406	VX5A474K	1-57318
C1113 - C1117	22 nf	PAP		12406	VX5A223K	1-57326
C1118 - C1119	0.22 uf	PAP	50V	12406	VX5A224K	1-57319
RESISTOR						
R1101	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1102	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1103	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1105	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1106	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1107	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1108	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1109	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1110	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1111	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1114	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272

CIMRON

PARTS LIST

ASSEMBLY: 10K Decade — CIMRON PART NO. 76-6011

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1115	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1116	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1117	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1118	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1119	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1120	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1123	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1124	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1125	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1126	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1127	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1128	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1129, R1130	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1131	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1132	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R1133	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1134	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252

CIMRON

PARTS LIST

ASSEMBLY: 10K Decade — CIMRON PART NO. 76-6011

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURE CODE	PART NO.	CIMRON PART NO.
RESISTOR						
R1135	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1136, R1137	270 KΩ	COMP	1/4W 5%	01121	CB-2745	7-41272
R1138	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1139	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R1140 - R1142	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1143	220 KΩ	COMP	1/4W 5%	01121	CB-2245	7-41271
R1144 - R1146	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1147 - R1150	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R1151	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1152	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1153	1.5 KΩ	COMP	1/4W 5%	01121	CB-1525	7-41245
R1154	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1155	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1156	1.5 KΩ	COMP	1/4W 5%	01121	CB-1525	7-41245
R1157	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
R1158	Factory Selected Value					
R1159, R1160	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255

CIMRON

PARTS LIST

ASSEMBLY: 10K Decade — CIMRON PART NO. 76-6011

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1161 - R1165	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1166	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1167	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1168	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1169, R1170	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R1171	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1172	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R1173, R1174	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R1175	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R1176	56 KΩ	COMP	1/4W 5%	01121	CB-5635	7-41264
R1177 - R1186	470 KΩ	COMP	1/4W 5%	01121	CB-4745	7-41275
R1187	330 KΩ	COMP	1/4W 5%	01121	CB-3345	7-41273
R1188	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R1189	47 KΩ	COMP	1/4W 5%	01121	CB-4735	7-41263
SEMICONDUCTOR						
CR1101 - CR1156		*CD-61 DIODE		15318		7-95511

CIMRON

PARTS LIST

ASSEMBLY: 10K Decade — CIMRON PART NO. 76-6011

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
TRANSISTOR						
Q1101 - Q1110				JEDEC	2N3567	9-04719
Q1111, Q1112				JEDEC	2N1309	9-04611
Q1113 - Q1122		CT-22 or 2N3114		15318		9-04705
Q1123, Q1124				JEDEC	2N3567	9-04719
Q1125, Q1126				JEDEC	2N1309	9-04611
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7011-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

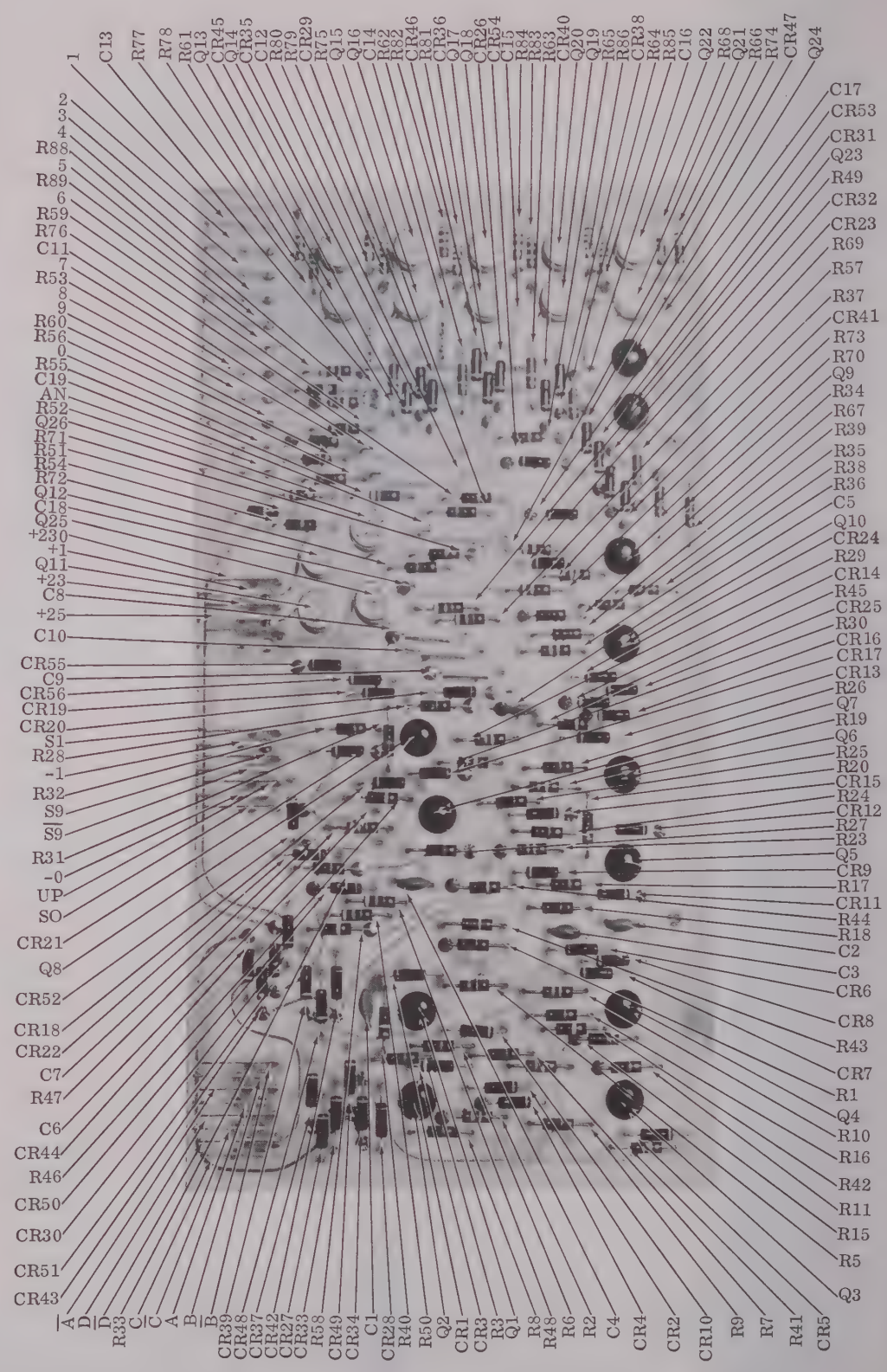
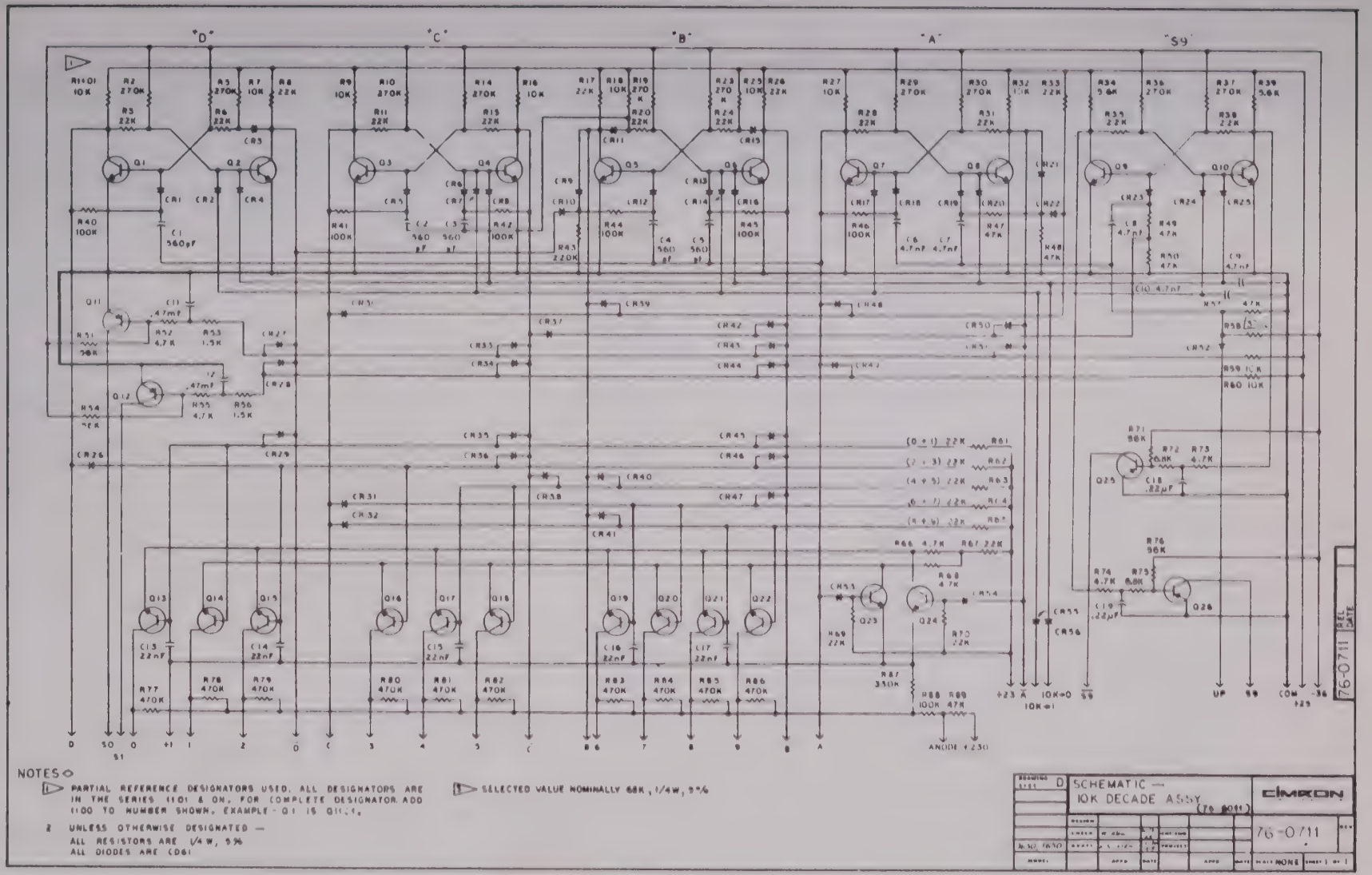


Figure 6-6. 10K Decade Assembly.



NOTES ◇

1. PARTIAL REFERENCE DESIGNATORS USED. ALL DESIGNATORS ARE IN THE SERIES 1101 & ON. FOR COMPLETE DESIGNATOR ADD 1100 TO NUMBER SHOWN. EXAMPLE - Q1 IS Q1101.
2. UNLESS OTHERWISE DESIGNATED — ALL RESISTORS ARE 1/4 W, 5% ALL DIODES ARE CD61
3. SELECTED VALUE NOMINALLY 68K, 1/4W, 5%

DRAWING SIZE D	SCHEMATIC — 10K DECADE ASSY (76-0711)	CIMRON	
		76-0711	REV
NEXT ASSY		NONE	SHEET 1 OF 1

CIMRON

PARTS LIST

ASSEMBLY: Range and Polarity — CIMRON PART NO. 76-6014

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1401, C1402	0.22 uf	MET PAP	50V	12406	VX5A224K	1-57319
C1403, C1404	1.8 nf	CER DISC	1000V	71590	DD-182	1-57503
C1405	47 nf	MET PAP	50V	12406	VX5A473K	1-57327
C1406, C1407	4.7 nf	MET PAP	50V	12406	VX5A472K	1-57331
RESISTOR						
R1401	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1402	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1403	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1404	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1405	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1406	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1407	1 MΩ	COMP	1/2W 5%	01121	EB-1055	7-41079
R1408, R1409	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1410	1 MΩ	COMP	1/2W 5%	01121	EB-1055	7-41079
R1411	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1412	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1413	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051

CIMRON

PARTS LIST

ASSEMBLY: Range and Polarity — CIMRON PART NO. 76-6014

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1414	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1415	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1416	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1417, R1418	5Ω	COMP WW	3%	04387	RS-1/2	7-47176
R1419, R1420	470 KΩ	COMP	1/2W 5%	01121	EB-4745	7-41075
R1421, R1422	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1423	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1424	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1425, R1426	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R1427	39 KΩ	COMP	1/2W 5%	01121	EB-3935	7-41062
R1428, R1429	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1430	68 KΩ	COMP	1/2W 5%	01121	EB-6835	7-41065
R1431	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1432, R1433	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1434, R1435	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1436	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1437	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059

CIMRON

PARTS LIST

ASSEMBLY: Range and Polarity — CIMRON PART NO. 76-6014

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1438, R1439	1 MΩ	COMP	1/2W 5%	01121	EB-1055	7-41079
R1440	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1441	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R1442	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1443 - R1445	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1446, R1447	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R1448	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1449	120 KΩ	COMP	1/2W 5%	01121	EB-1245	7-41068
R1450, R1451	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R1452	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R1453	470 KΩ	COMP	1/2W 5%	01121	EB-4745	7-41075
R1454	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1455	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R1456	470 KΩ	COMP	1/2W 5%	01121	EB-4745	7-41075
R1457	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R1458	470 KΩ	COMP	1/2W 5%	01121	EB-4745	7-41075
R1459	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071

CIMRON

PARTS LIST

ASSEMBLY: Range and Polarity — CIMRON PART NO. 76-6014

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1460 - R1462	6.8 KΩ	COMP	1/2W 5%	01121	EB-6825	7-41052
SEMICONDUCTOR						
CR1401, CR1402		*CD-61 DIODE		15318		7-95511
CR1403		ZENER DIODE		JEDEC	1N712	7-95611
CR1404, CR1405		*CD-61 DIODE		15318		7-95511
CR1406, CR1407		**CD-62 DIODE		15318		7-95507
CR1408 - CR1416		*CD-61 DIODE		15318		7-95511
CR1417		**CD-62 DIODE		15318		7-95507
CR1418 - CR1426		*CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q1401, Q1402				JEDEC	2N3440	9-04801
Q1403, Q1404				JEDEC	2N3567	9-04719
Q1405, Q1406		CT-22 or 2N3114		15318		9-04705
Q1407				JEDEC	2N3440	9-04801
Q1408, Q1409				JEDEC	2N1309	9-04611
Q1410 - Q1414				JEDEC	2N3567	9-04719

CIMRON

PARTS LIST

ASSEMBLY: Range and Polarity — CIMRON PART NO. 76-6014

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
TRANSISTOR						
Q1415 - Q1417				JEDEC	2N3440	9-04801
MISCELLANEOUS						
L1401 - L1404		REED SWITCH ACTUATOR SOLENOID		15318		70-0501-1
S1401 - S1404		RELAY SWITCH MAG REED		12617	DRS-1	7-38217
		ETCHED CIRCUIT BOARD		15318		76-7014-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

**CD-62, I_f = 1V greater than 100 ma, I_r = 300V less than 1 ua, SILICON

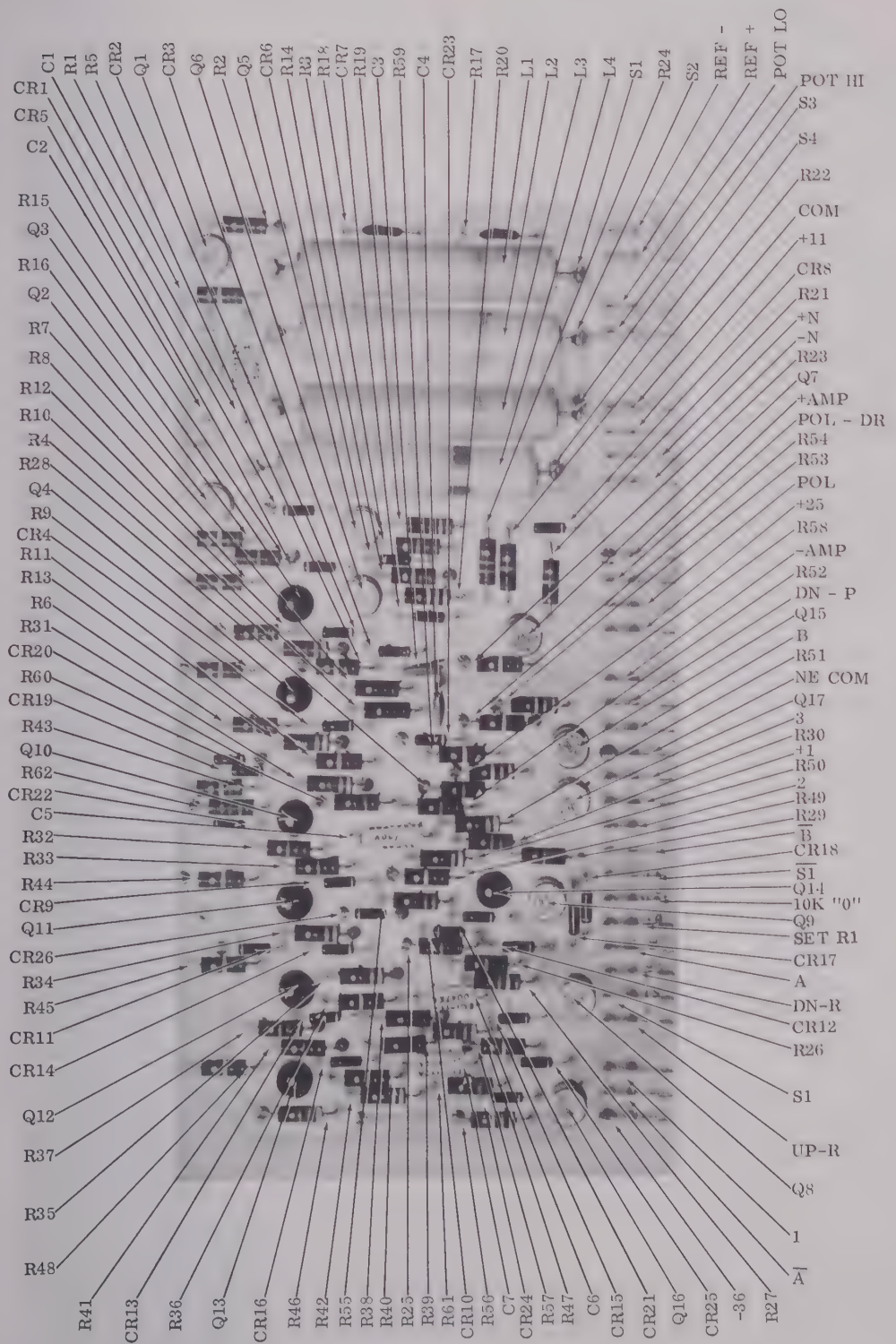
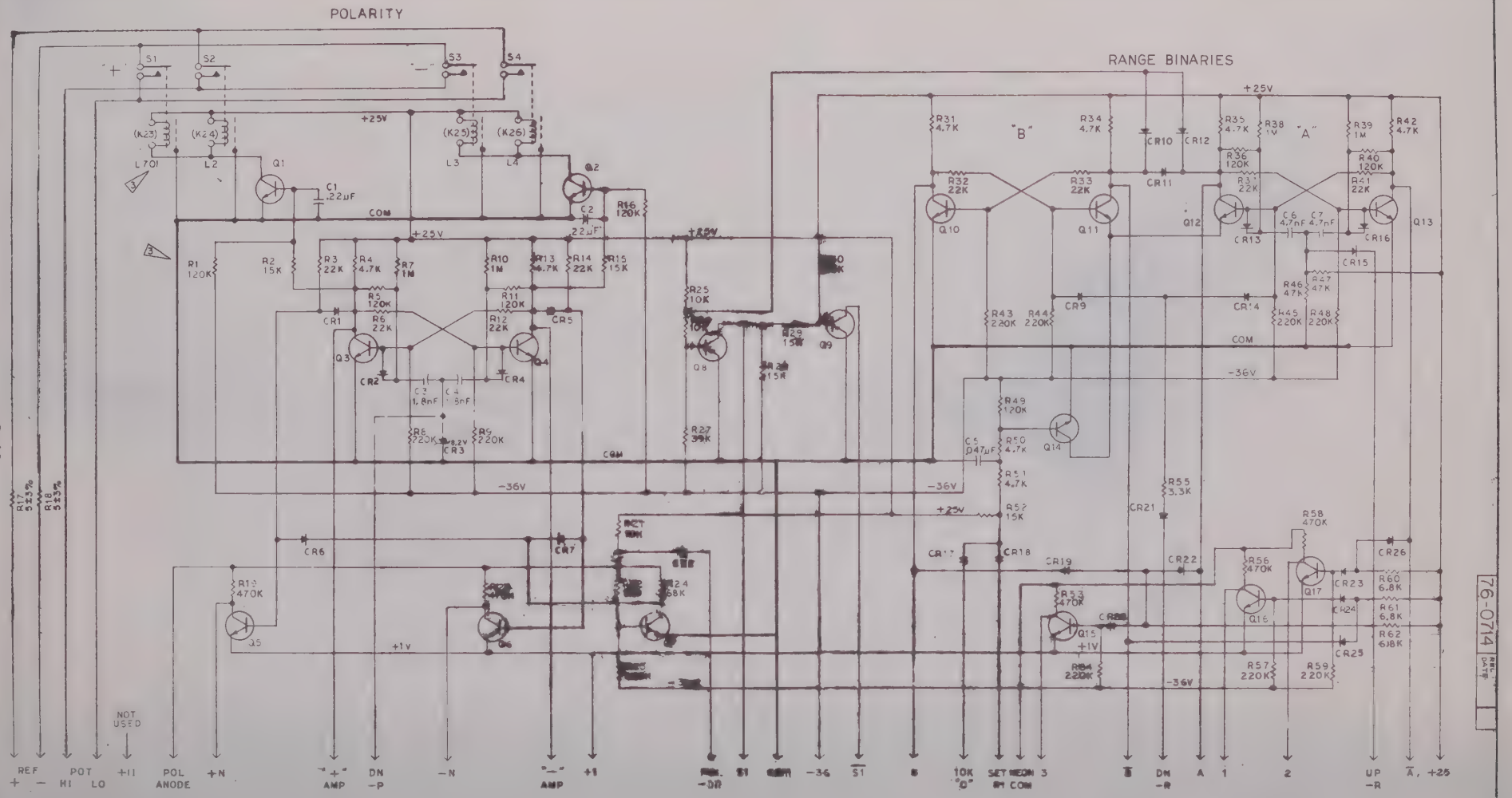


Figure 6-7. Range and Polarity Assembly.



NOTES ◇

1. PLUG-IN PIN CONNECTIONS NOT SHOWN IN SAME ORDER AS ON ASSEMBLY.
2. UNLESS OTHERWISE NOTED, RESISTORS ARE ½ WATT & ±5% TOLERANCE.

▶ PARTIAL REFERENCE DESIGNATIONS SHOWN. ALL NUMBERS ARE IN THE SERIES 1400 & ON. EXAMPLE: R1 IS R1401.

SCHEMATIC — 76-6014 RANGE & POLARITY ASSY

76-0714

6-48

76-0714

CIMRON

PARTS LIST

ASSEMBLY: Print Control — CIMRON PART NO. 76-6023

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1	1 uf	PAP	50V	12406	VX5A105K	1-57317
C2	1.8 nf	CER DISC		71590	DD-182	1-57503
C3, C4	20 uf	ELECT	50V	14655	NLW 20-50	1-57256
RESISTOR						
R1	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R2	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R3	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R4	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R5	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R6	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R7	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R8	1 MΩ	VAR	1/2W 5%	01121	EB-1055	7-48806
R9	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
R10	330Ω	COMP	1/2W 5%	01121	EB-3315	7-41037
R11	3.3 KΩ	COMP	1/2W 5%	01121	EB-3325	7-41049
R12	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R13	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071

CIMRON

PARTS LIST

ASSEMBLY: Print Control — CIMRON PART NO. 76-6023

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R14	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R15	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R16	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R17	5.6 KΩ	COMP	1/2W 5%	01121	EB-5625	7-41052
R18	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R19	100Ω	COMP	1/2W 5%	01121	EB-1015	7-41031
R20	27 KΩ	COMP	1/2W 5%	01121	EB-2735	7-41060
R21	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
R22	15 KΩ	COMP	1/2W 5%	01121	EB-1535	7-41057
R23	10 KΩ	COMP	1/2W 5%	01121	EB-1035	7-41055
R24	220 KΩ	COMP	1/2W 5%	01121	EB-2245	7-41071
SEMICONDUCTOR						
CR1 - CR14		*CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q1 - Q3				JEDEC	2N3567	9-04719
Q4		UNIJUNCTION		JEDEC	2N2647, 4JD5E29 or 4JDX5E738	9-04400

CIMRON

PARTS LIST

ASSEMBLY: Print Control — CIMRON PART NO. 76-6023

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
TRANSISTOR						
Q5 - Q8				JEDEC	2N3567	9-04719
MISCELLANEOUS						
K1		REED COIL		15318		70-0511-1
K2		REED COIL		15318		70-0501-1
S1		REED SWITCH		95348	MR-306-8	7-38216
S2		REED SWITCH		12617	DRG-1	7-38208
		ETCHED CIRCUIT BOARD		15318		76-7023-3

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

NOTE:

PARTIAL REFERENCE DESIGNATIONS SHOWN.

FOR COMPLETE DESIGNATOR ADD 2300.

EXAMPLE: C1 is C2301

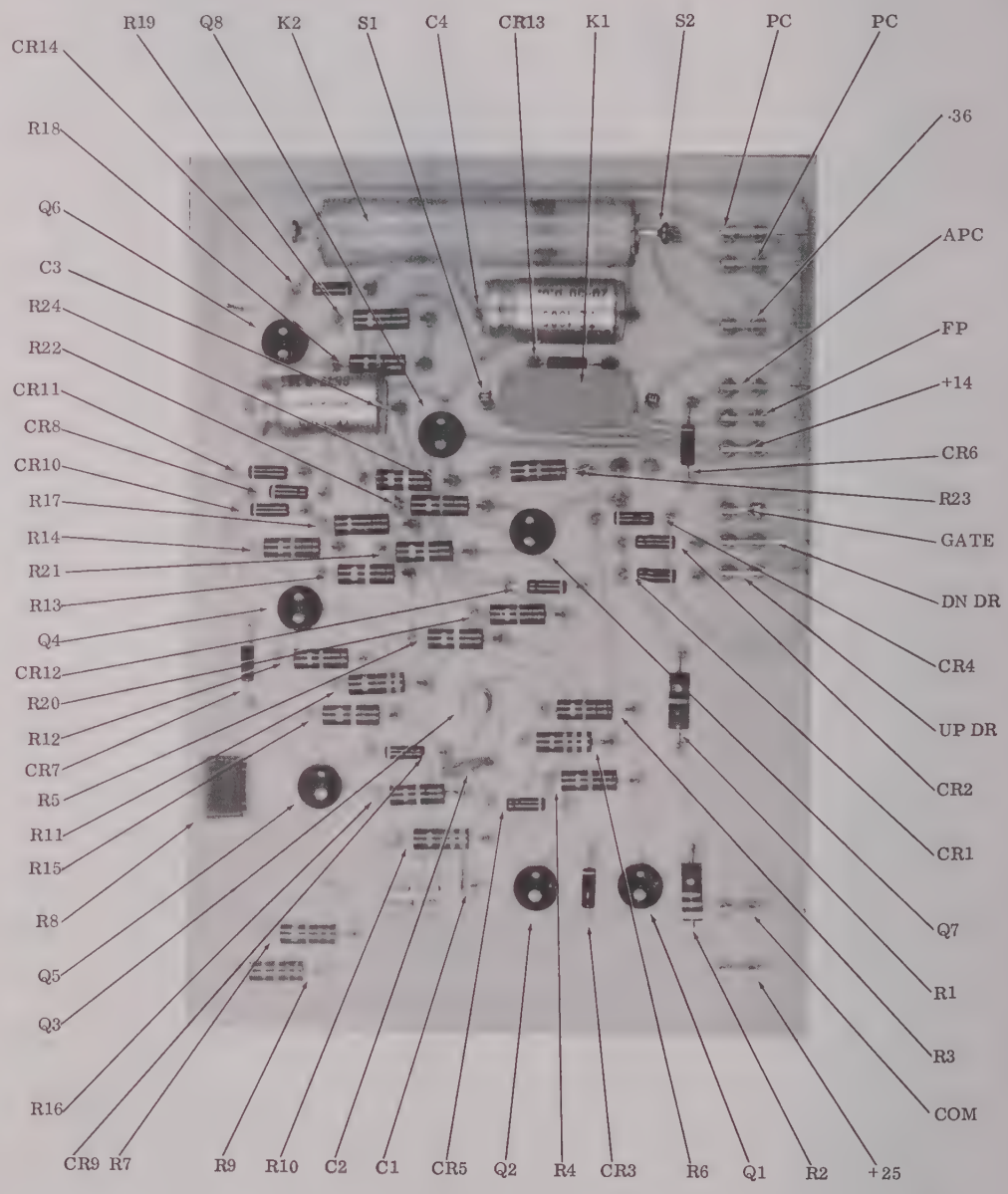
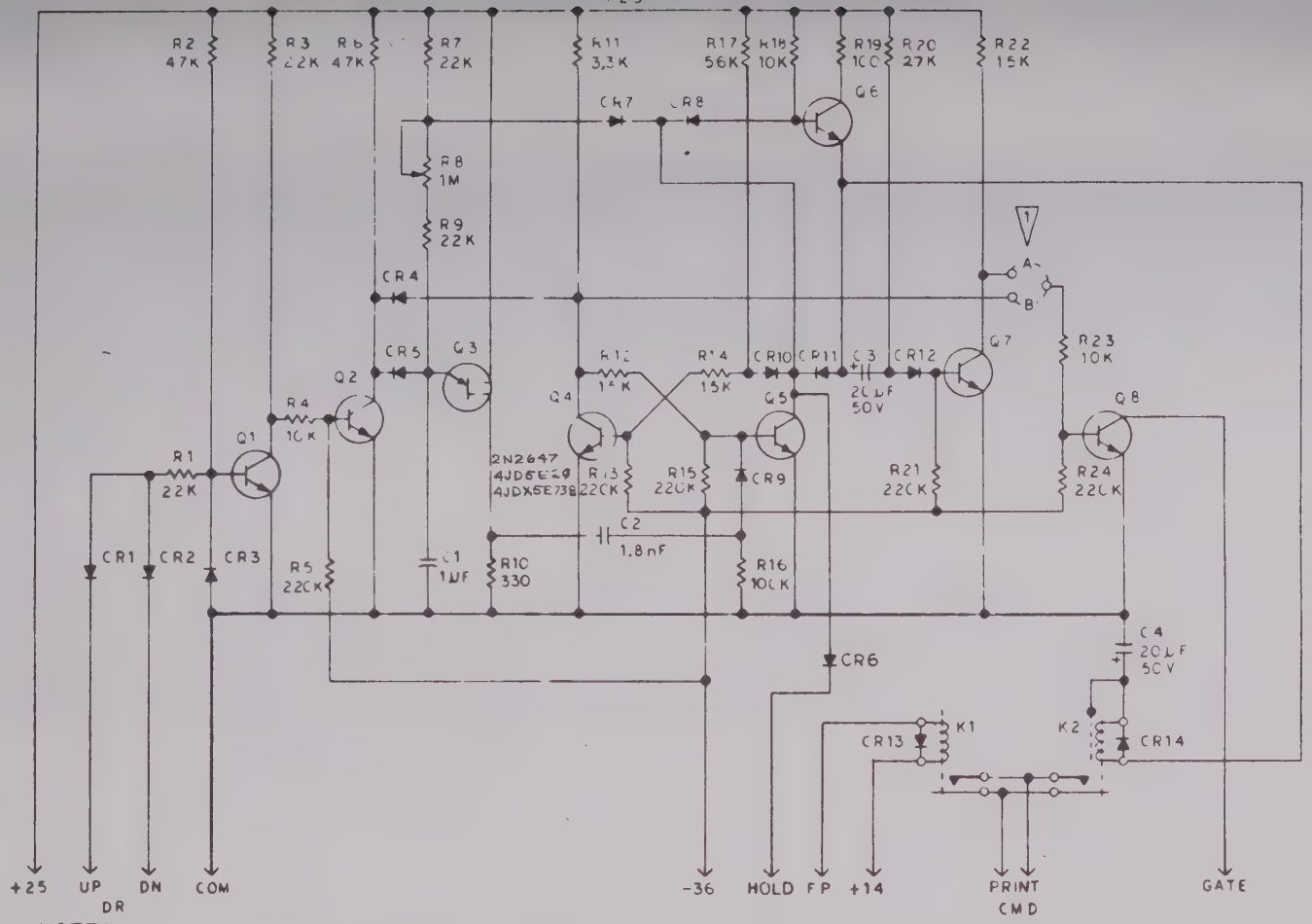


Figure 6-8. Print Control Assembly.



NOTES

1. THE CIRCUIT BOARD WILL NORMALLY BE ASSEMBLED AND SHIPPED WITH JUMPER "A" INSTALLED.
2. MANUAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 2300 EXAMPLE R1 IS R2301.
3. ALL DIODES ARE CD-61
4. Q1-Q3 & Q5-Q8 ARE 2N3567
5. ALL RESISTORS ARE ±5%, 1/2W
6. LAST NO USED: C4, CR14, K2, Q8, R24 | NO.'S NOT USED: NONE

MODEL	7650
CHF ENG	
PROJECT	
DESIGN	
CHECK	
DRAFT	B. CHARLES 3/65

76-0723

REL DATE	A
DRAWING SIZE	C

SCHEMATIC
PRINT CONTROL
ASSY 76-6023

CIMRON

76-0723 REV B

CIMRON

PARTS LIST

ASSEMBLY: Print Output "A" — CIMRON PART NO. 76-6008

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR						
R1	22KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
SEMICONDUCTOR						
Odd (CR1, CR3, etc. thru CR33)		*CD-61 DIODE		15318		7-95511
Even (CR2, CR4, etc. thru CR34)		**CD-62 DIODE		15318		7-95507
MISCELLANEOUS						
K1 - K17		COIL REED DRIVE		15318		70-0511-1
S1 - S17		RELAY REED		95348	MR-306-8	7-38216
J2		CONN RECEPT 50 PIN		02660	57-40500	2-50150
		ETCHED CIRCUIT BOARD		15318		76-7008-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

**CD-62, I_f = 1V greater than 100 ma, I_r = 300V less than 6 ua, SILICON

NOTE:
PARTIAL REFERENCE DESIGNATIONS SHOWN.
FOR COMPLETE DESIGNATION ADD 800.
EXAMPLE: R1 is R801

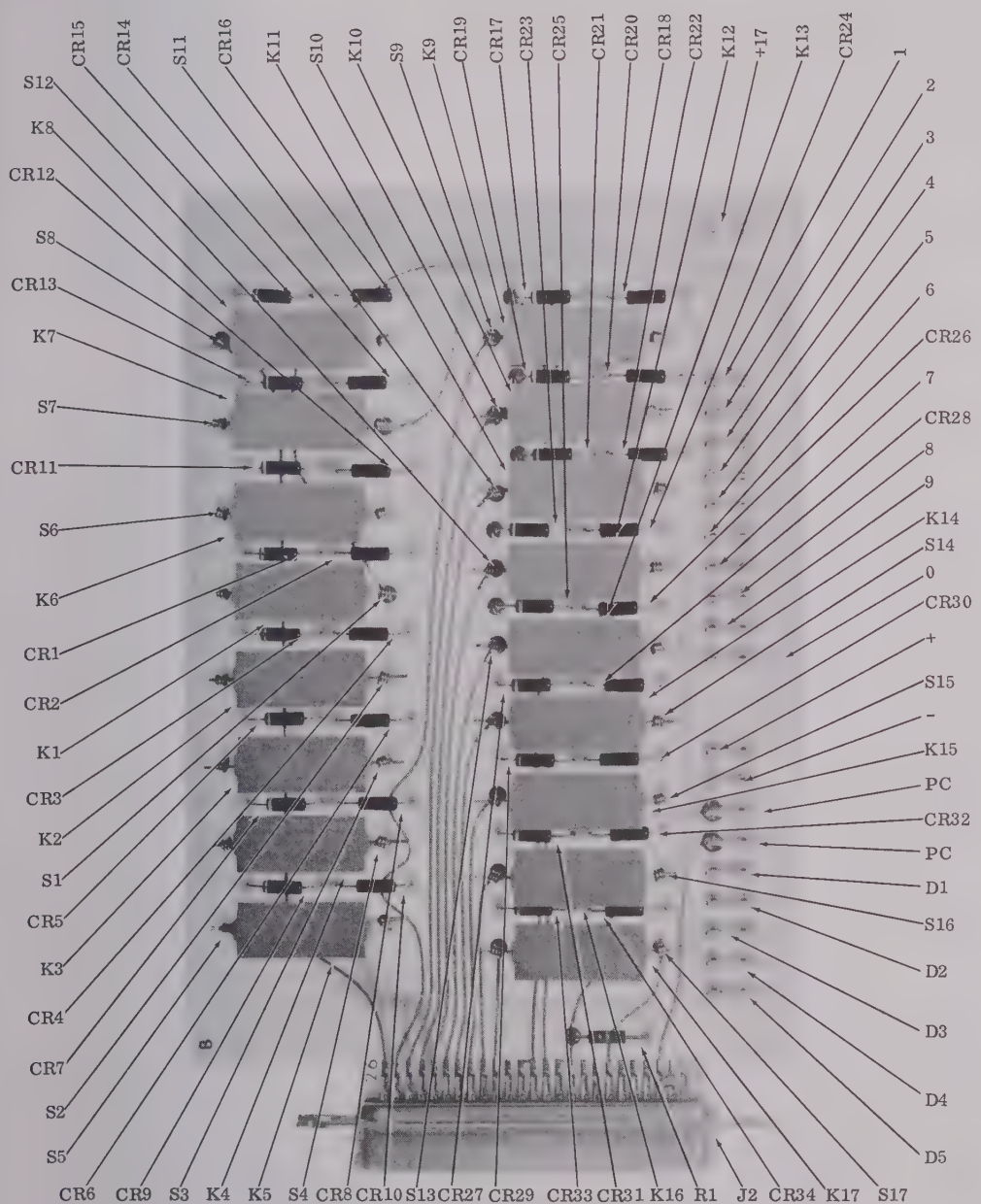
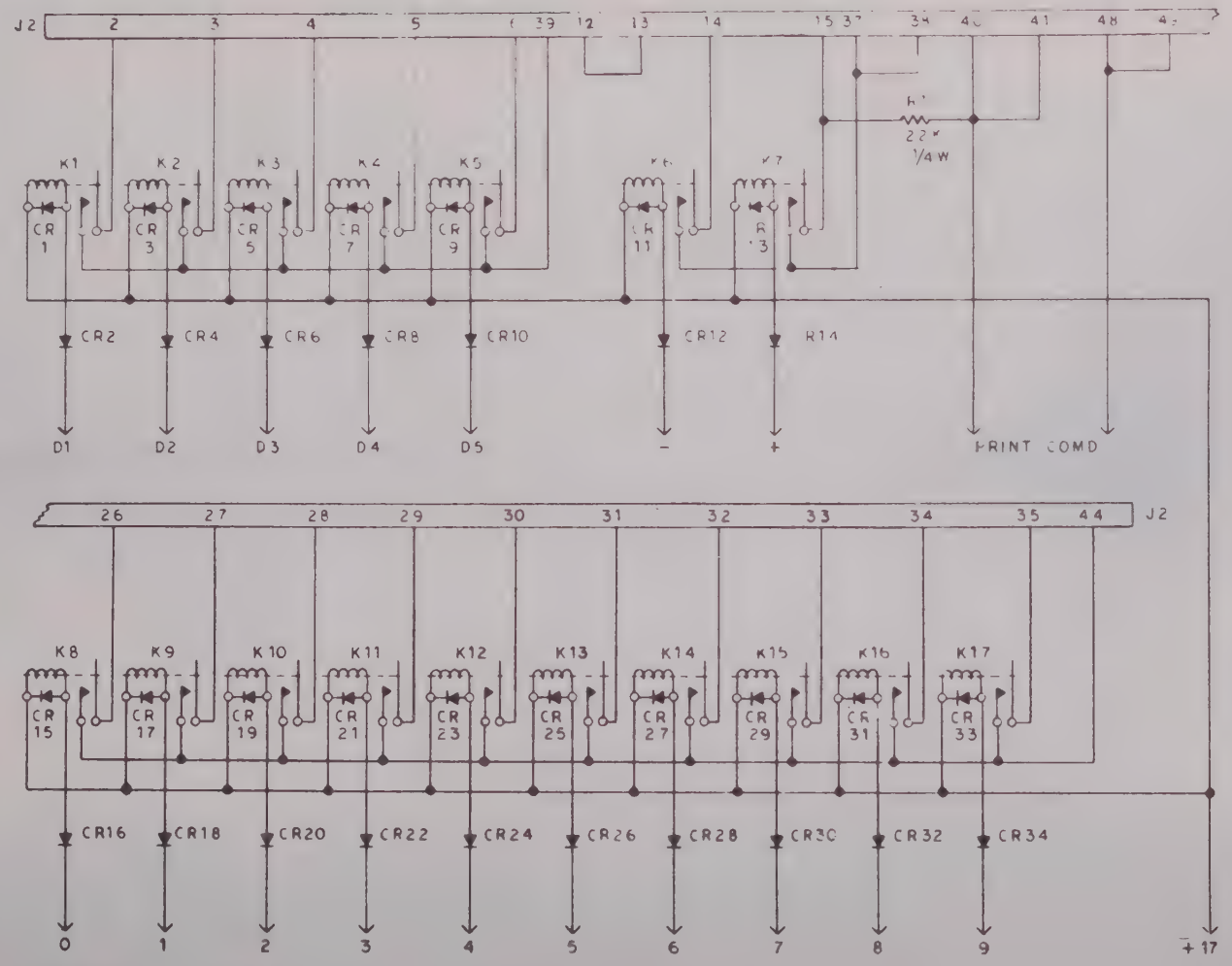


Figure 6-9. Print Output "A" Assembly.



NOTES◇

1. ALL EVEN NUMBERED DIODES ARE CD-62.
   ALL ODD NUMBERED DIODES ARE CD-61.
2. LAST NO USED: CR3, K17, R1, J1. | NO'S NOT USED: NONE
3. PARTIAL REFERENCE DESIGNATIONS SHOWN
   FOR COMPLETE DESIGNATION ADD 800

MODEL	7650
CHF ENG	
PROJECT	
DESIGN	
CHECK	
DRAFT	B. CHARLES 9/30/65

76-0708

REL DATE	
DRAWING SIZE	C

SCHEMATIC
PRINT OUTPUT
"A"
ASSY 76-6008

CIMRON CORPORATION

76-0708

CIMRON

PARTS LIST

ASSEMBLY: Print Output "B" — CIMRON PART NO. 76-6009

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
SEMICONDUCTOR						
Odd (CR1, CR3, etc. thru CR39)		*CD-61 DIODE		15318		7-95511
Even (CR2, CR4, etc. thru CR40)		**CD-62 DIODE		15318		7-95507
MISCELLANEOUS						
K1 - K20		COIL REED DRIVE		15318		70-0511-1
S1 - S20		RELAY REED		95348	MR-306-8	7-38216
J3		CONN RECEPT 50 PIN		02660	57-40500	2-50150
		ETCHED CIRCUIT BOARD		15318		76-7009-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

**CD-62, I_f = 1V greater than 100 ma, I_r = 300V less than 6 ua, SILICON

NOTE:
PARTIAL REFERENCE DESIGNATIONS SHOWN.
FOR COMPLETE DESIGNATOR ADD 900.
EXAMPLE: CR1 is CR901

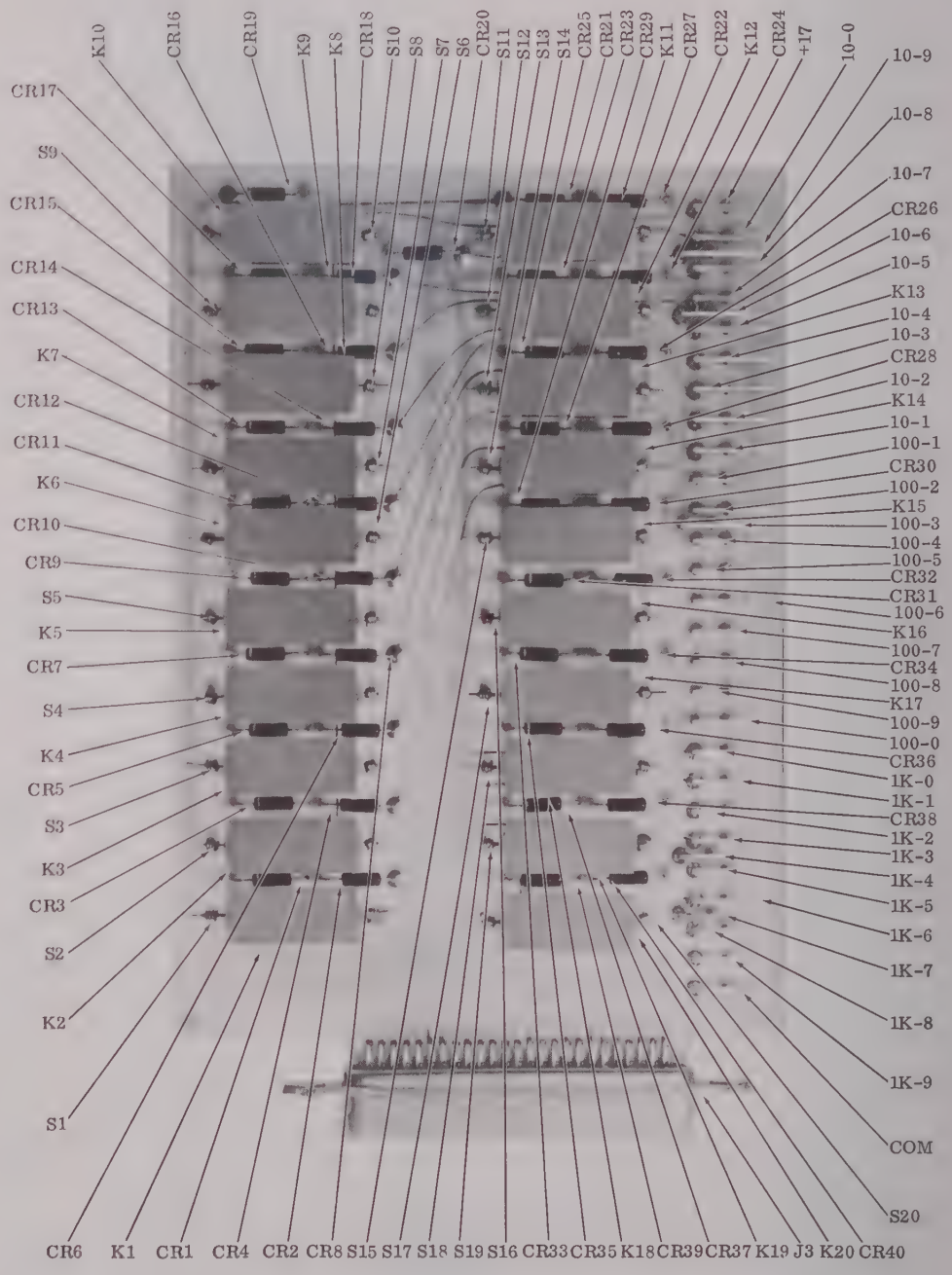
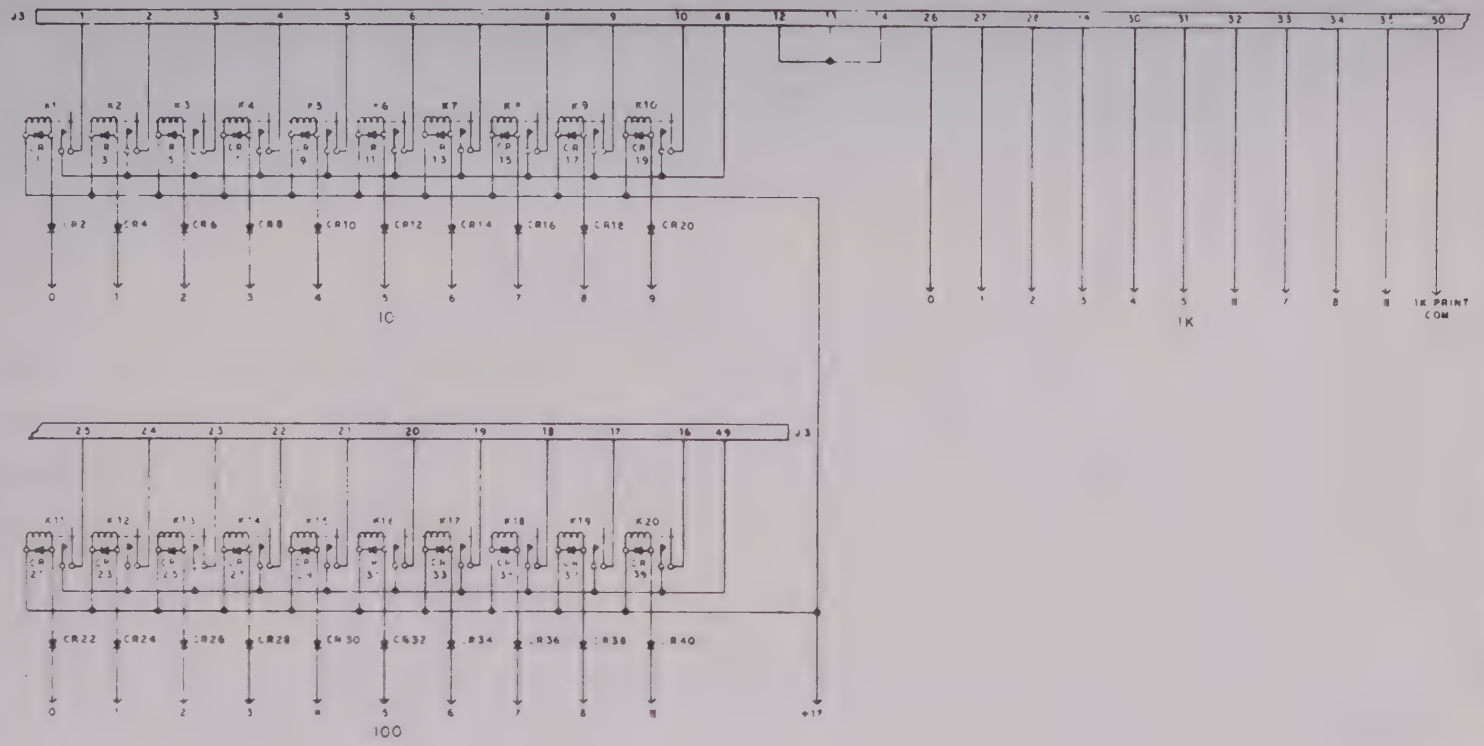


Figure 6-10. Print Output "B" Assembly.



NOTES:

1. ALL EVEN NUMBERED DIODES ARE "C" & "E"
   ALL ODD NUMBERED DIODES ARE "D" & "F"
2. LAST NO USED: CR40, R20 | NO'S NOT USED: NONE
3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 900
   EXAMPLE: CR1 = CR 901

7E50

7E-0709

D

SCHEMATIC
PRINT OUTPUT
8
ASSY 7E-[illegible]

CIMRON

7E-[illegible]

CIMRON

PARTS LIST

ASSEMBLY: Print Output "C" CIMRON PART NO. 76-6010

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
SEMICONDUCTOR						
Odd (CR1, CR3, etc. thru CR19)		*CD-61 DIODE		15318		7-95511
Even (CR2, CR4, etc. thru CR20)		**CD-62 DIODE		15318		7-95507
MISCELLANEOUS						
K1 - K10		COIL REED DRIVE		15318		70-0511-1
S1 - S10		RELAY REED		95348	MR-306-8	7-38216
		ETCHED CIRCUIT BOARD		15318		76-7010-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

**CD-62, I_f = 1V greater than 100 ma, I_r = 300V less than 6 ua, SILICON

NOTE:
PARTIAL REFERENCE DESIGNATIONS SHOWN.
FOR COMPLETE DESIGNATION ADD 1000.
EXAMPLE: CR1 is CR1001

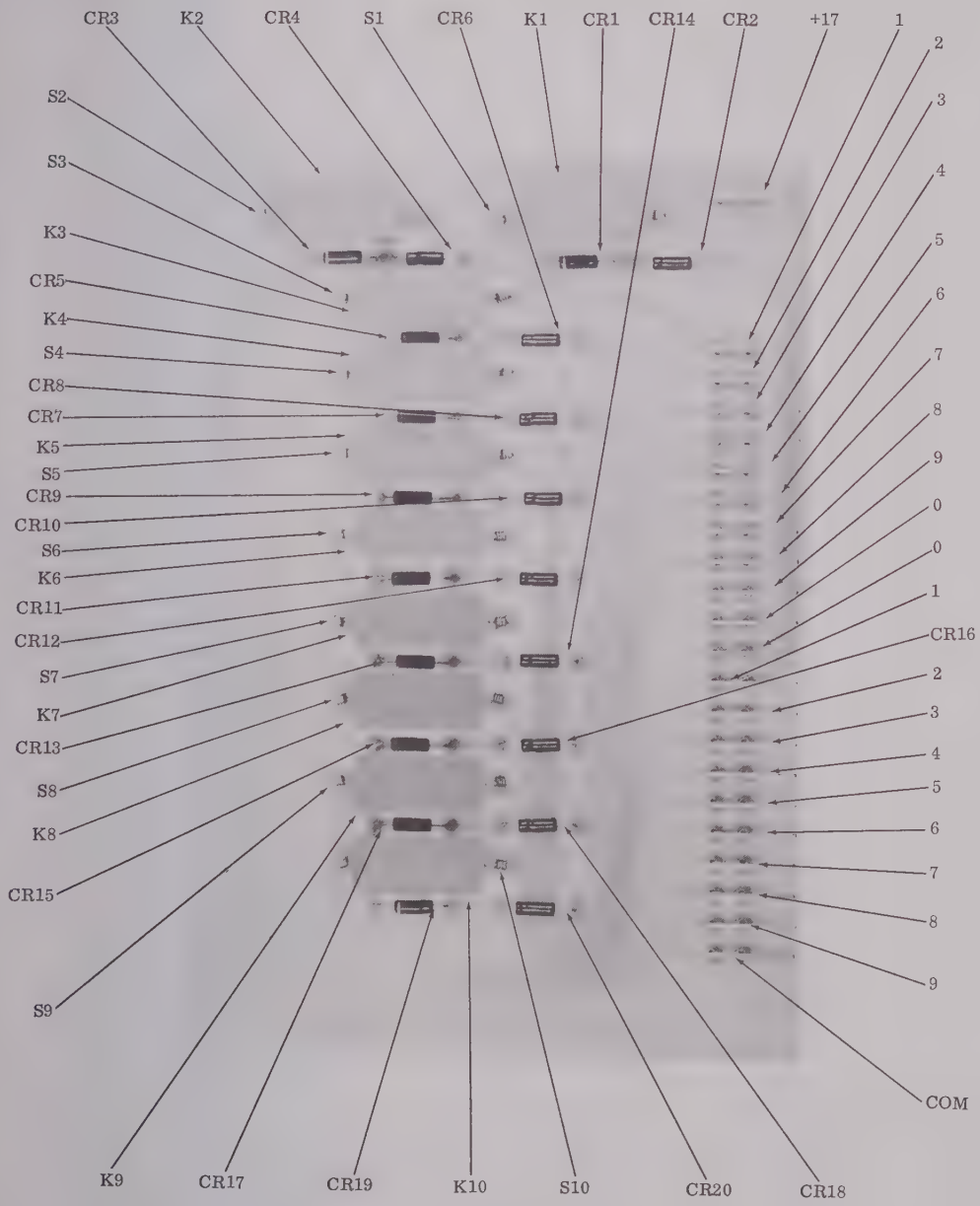
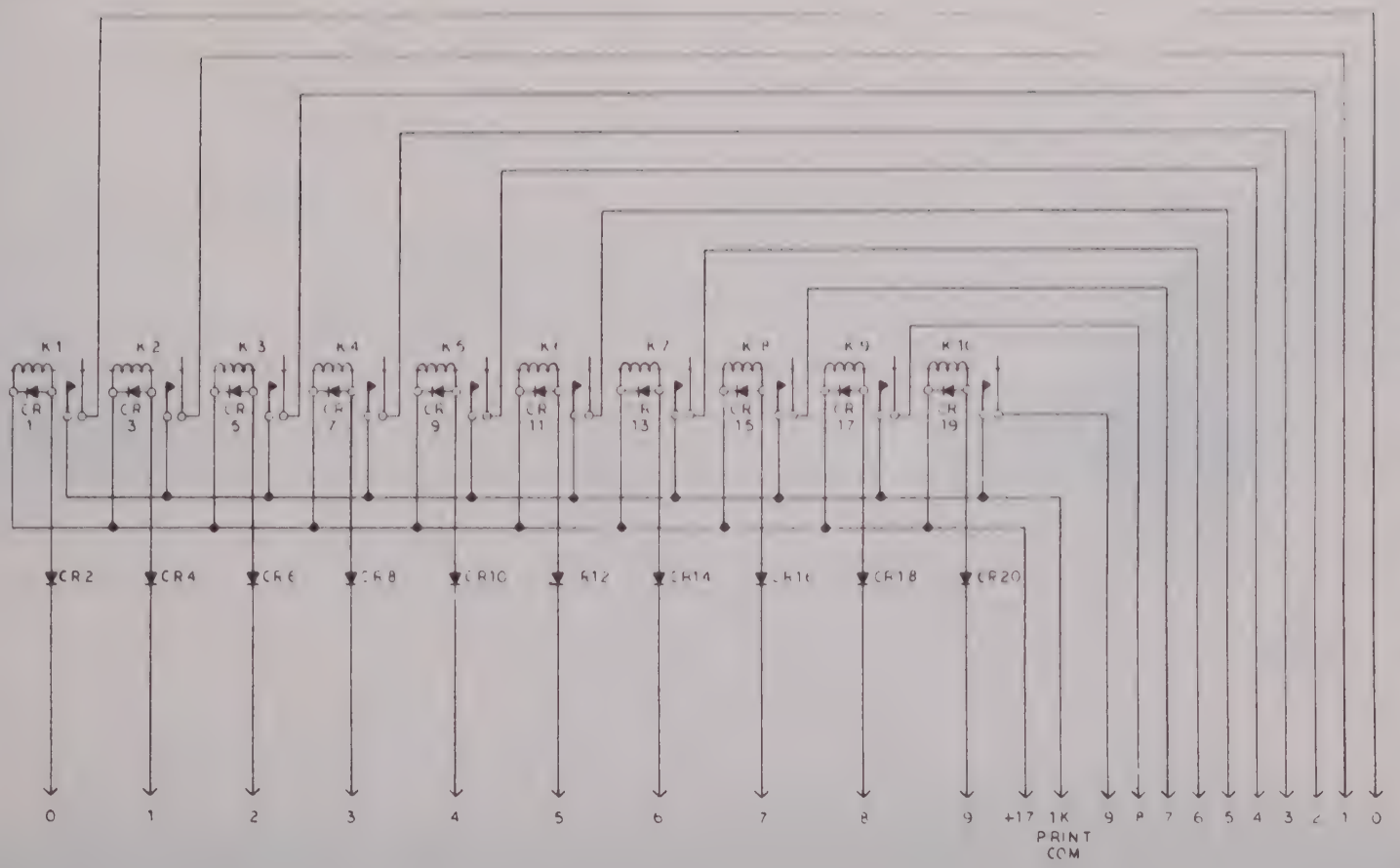


Figure 6-11. Print Output "C" Assembly.



MODEL	7650
CHF ENG	
PROJECT	
DESIGN	
CHECK	
DRAFT	H CHARLES 12/3/63

76-0710	
DEL DATE	
DRAWING SIZE	C

SCHEMATIC
PRINT OUTPUT
"C"
ASSY 76-6010

CIMRON CORPORATION

NOTES◇

1 ALL EVEN NUMBERED DIODES ARE CD 62
ALL ODD NUMBERED DIODES ARE CD 61

2

LAST NO USED	NO'S NOT USED
CR20, K10	NONE

3. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATION ADD 1000
EXAMPLE K1 is K1001

CIMRON

PARTS LIST

ASSEMBLY: Print Output "D" CIMRON PART NO. 76-6007

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
SEMICONDUCTOR						
Odd (CR1, CR3, etc. thru CR29)		*CD-61 DIODE		15818		7-95511
Even (CR2, CR4, etc. thru CR30)		**CD-62 DIODE		15818		7-95507
MISCELLANEOUS						
K1 - K15		COIL REED DRIVE		15818		70-0511-1
S1 - S15		RELAY REED		95348	MR-306-8	7-38216
J4		CONN RECEPT 50 PIN		02660	57-40500	2-50150
		ETCHED CIRCUIT BOARD		15818		76-7007-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

**CD-62, I_f = 1V greater than 100 ma, I_r = 300V less than 6 ua, SILICON

NOTE:
PARTIAL REFERENCE DESIGNATIONS SHOWN.
FOR COMPLETE DESIGNATOR ADD 700.
EXAMPLE: CR1 is CR701

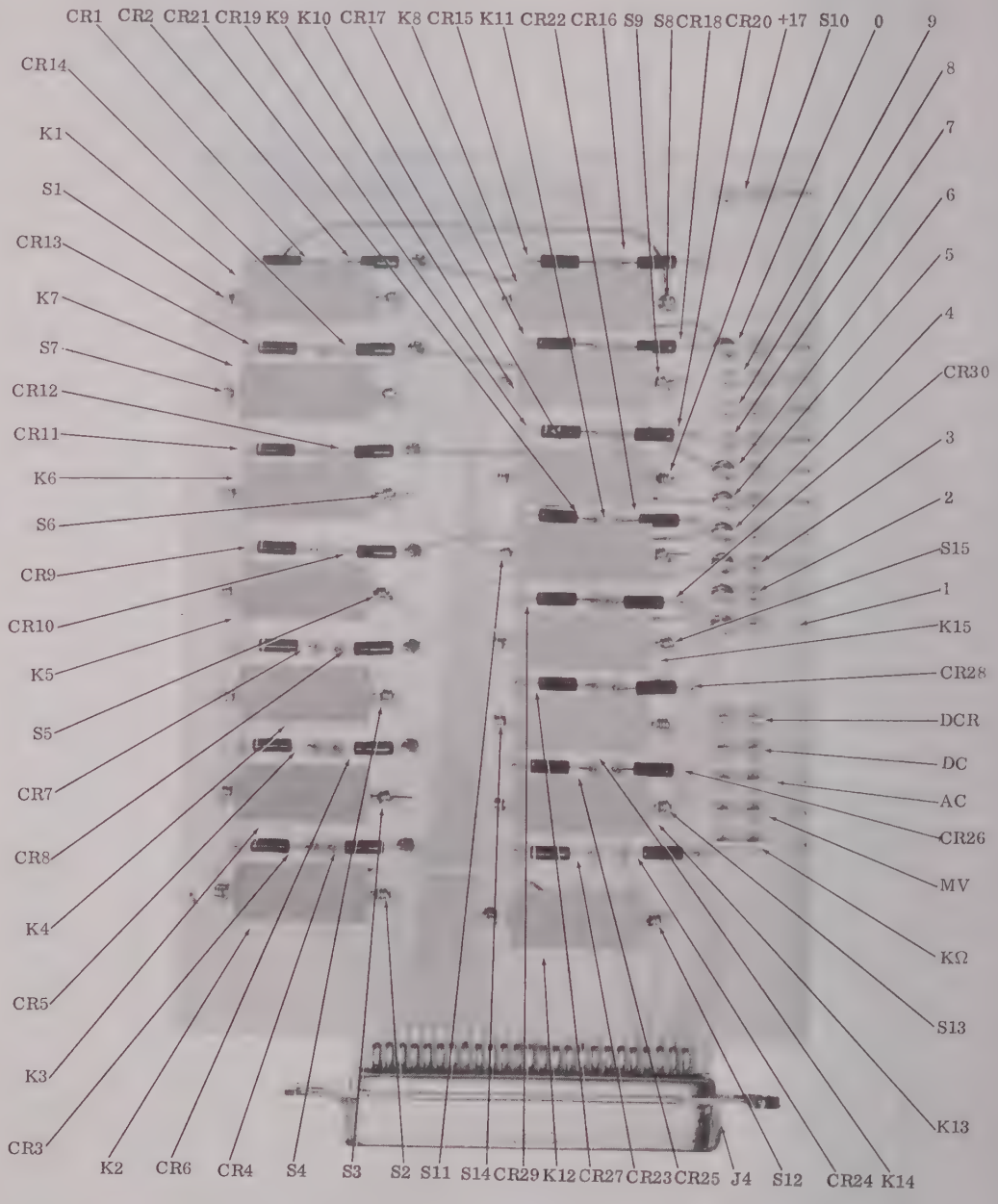
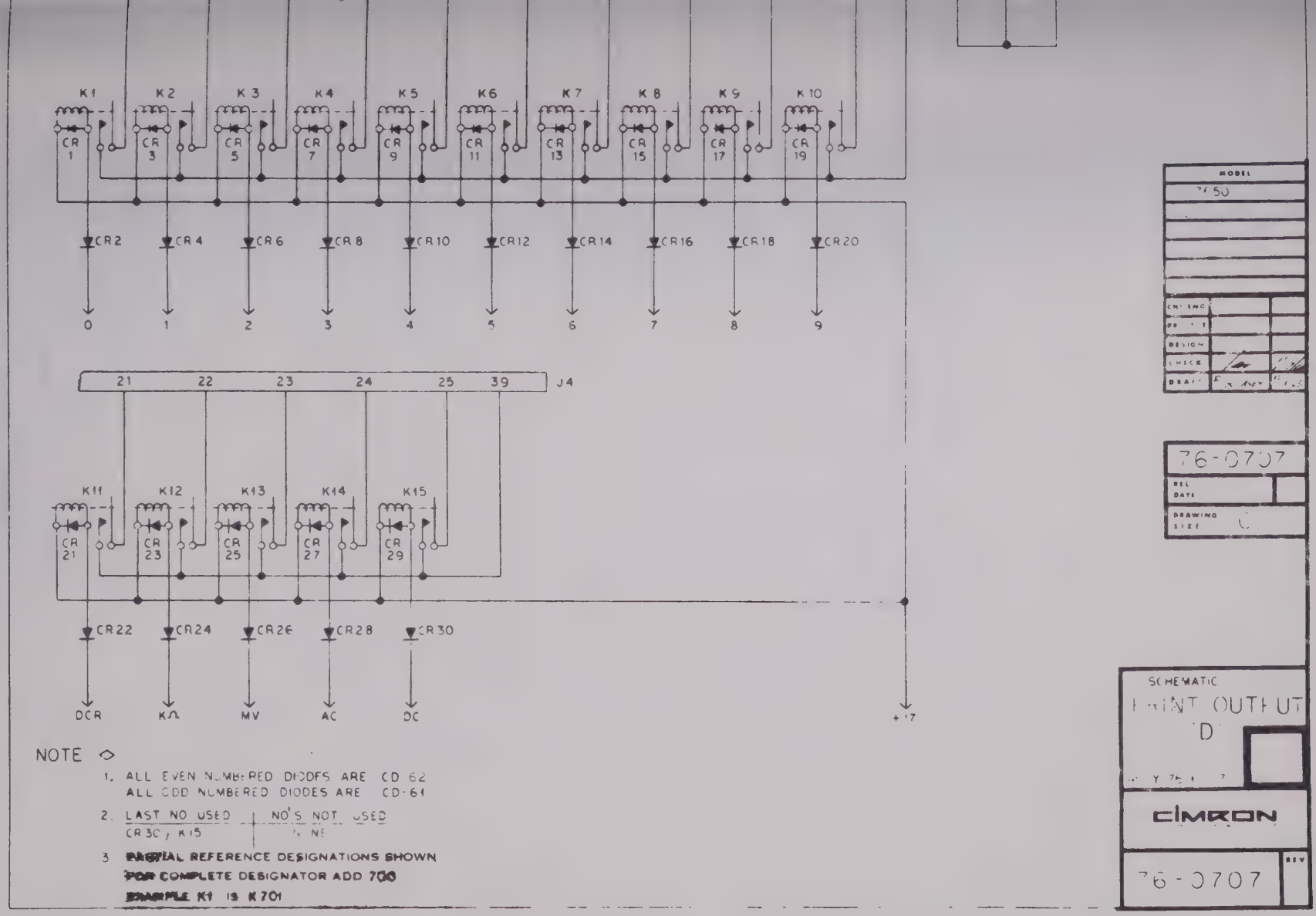


Figure 6-12. Print Output "D" Assembly.



NOTE ◇

1. ALL EVEN NUMBERED DIODES ARE CD 62
   ALL ODD NUMBERED DIODES ARE CD-61
2. LAST NO USED | NO'S NOT USED
   CR30 ; K15 | NONE
3. PARTIAL REFERENCE DESIGNATIONS SHOWN
   FOR COMPLETE DESIGNATOR ADD 700
   EXAMPLE K1 IS K701

MODEL 7650

76-0707

DRAWING SIZE C

SCHEMATIC
PRINT OUTPUT
D

CIMRON

76-0707 REV

CIMRON

PARTS LIST

ASSEMBLY: Reference and Ratio — CIMRON PART NO. 76-6024

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR						
R2401	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R2402	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R2403	120 KΩ	COMP	1/4W 5%	01121	CB-1245	7-41268
R2404	5 KΩ	VAR TRIM WW		97704	1PC5K	7-54241
R2405	200Ω	VAR TRIM WW		97704	1PC200Ω	7-54239
R2406, R2407	Factory Selected Value					
SEMICONDUCTOR						
CR2401 - CR2404		*CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q2401				JEDEC	2N3567	9-04719
MISCELLANEOUS						
Z2401	VOLTAGE REFERENCE STANDARD 1 MA			15318		76-0501-1
K2401, K2402	RELAY 3 PDT			21226	18-BW3-G	7-38214
	ETCHED CIRCUIT BOARD			15318		76-7024- 3
C2401	CAPACITOR, POLY STY, 1 uf, 100V 10%			12406	PD1A105K	1-57361

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

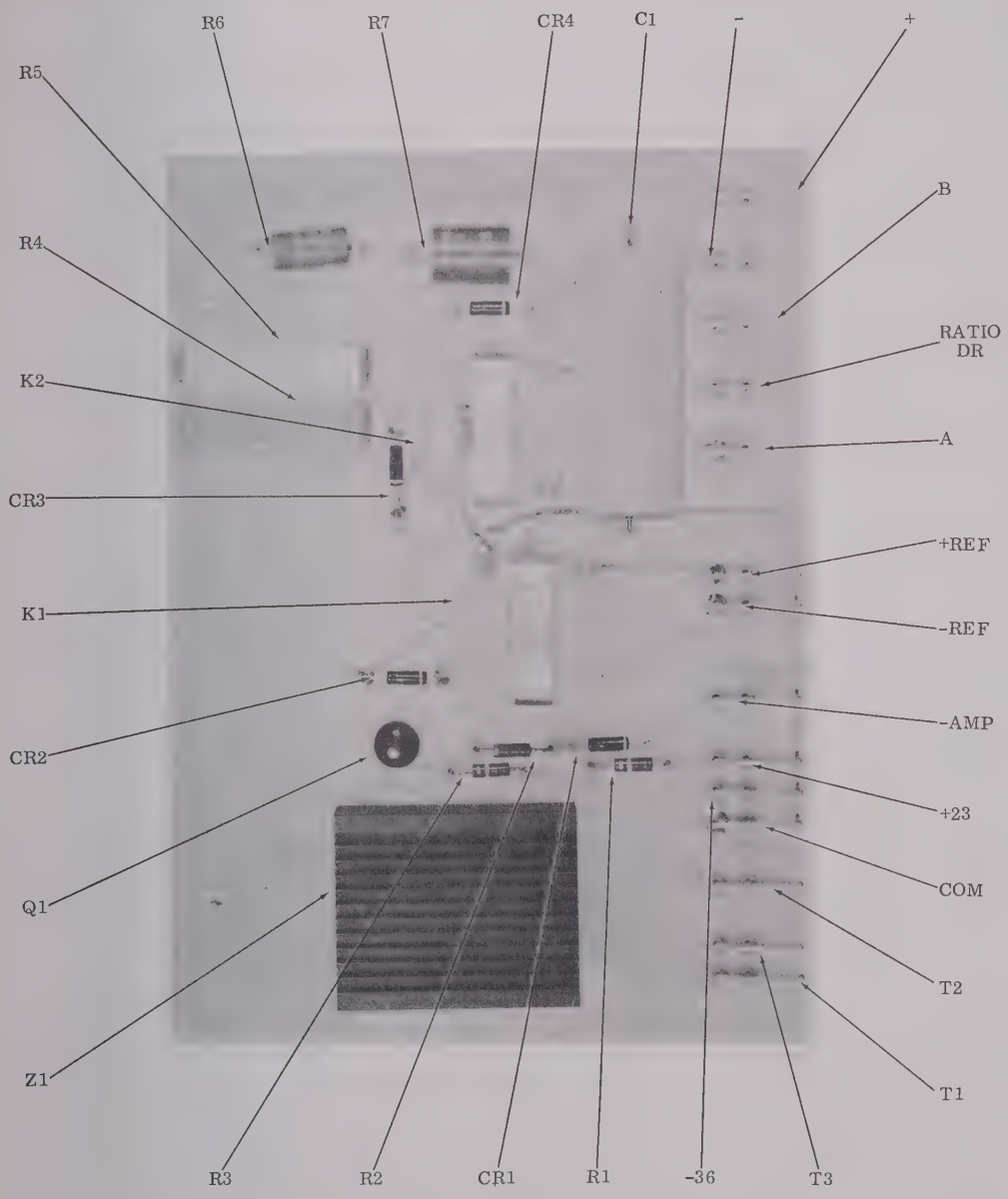
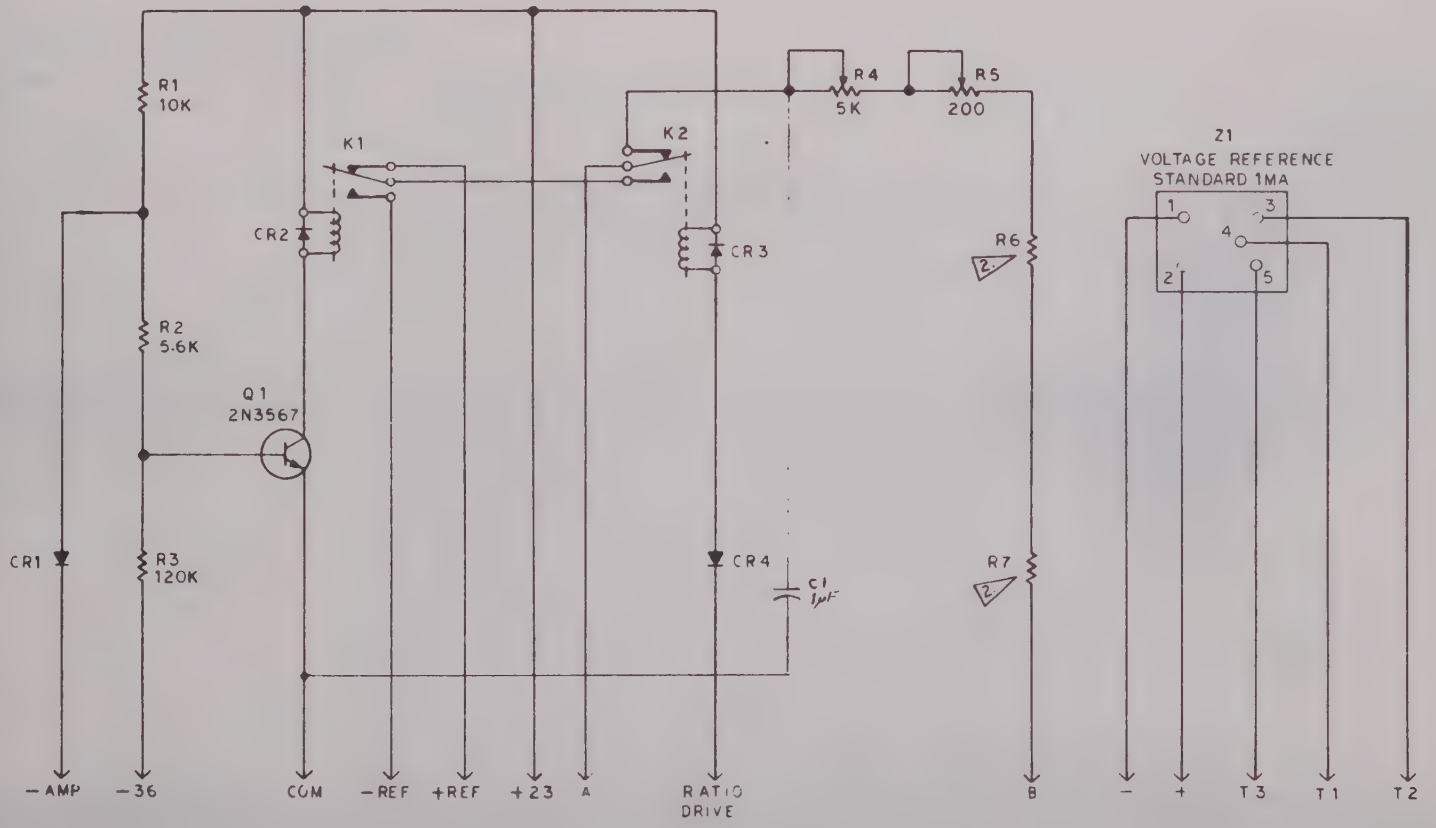


Figure 6-13. Reference and Ratio Assembly.



MODEL
7650
7630

CHF ENG		
PROJECT		
DESIGN		
CHECK		
DRAFT	B. HALES	1/5/66

76-0724

REL DATE	
DRAWING SIZE	C

NOTES:

1. ALL RESISTORS ARE ±5%, 1/4W UNLESS NOTED OTHERWISE.
2. FACTORY SELECTED VALUE.
3. CR1-4 ARE CD-C1.
4. LAST NO USED: CR4, K2, Q1, R7, Z1. | NO'S NOT USED: NONE
5. PARTIAL REFERENCE DESIGNATIONS SHOWN. FOR COMPLETE DESIGNATOR ADD 2400 EXAMPLE R4 IS R2401

SCHEMATIC
REFERENCE & RATIO SW
ASSY 76-6024

CIMRON

CIMRON

PARTS LIST

ASSEMBLY: "A" Potentiometer — CIMRON PART NO. 76-6019

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR						
*R1 - R6	20 KΩ	WW RATIOED		15318		5-40011*
*R7 - R10	2 KΩ	WW RATIOED		15318		5-40011*
R11	Factory Selected Value					
R12	1110.1Ω	PRECISION	0.01%	07088	OB	7-47119
*R13, R14	2 KΩ	WW RATIOED		15318		5-40011*
R15	2 KΩ	PRECISION	0.025%	07088	OB	7-47117
R16	4 KΩ	PRECISION	0.025%	07088	OB	7-47118
SEMICONDUCTOR						
CR1 - CR20		**CD-61 DIODE		15318		7-95511
MISCELLANEOUS						
K1 - K10		LOW THERMAL SWITCH		15318		70-0509
		ETCHED CIRCUIT BOARD		15318		76-7019-1

*These resistors must be replaced as one unit under Part Number 5-40011.

NOTE:
PARTIAL REFERENCE DESIGNATIONS SHOWN.
FOR COMPLETE DESIGNATION ADD 1900.
EXAMPLE: R1 is R1901

**CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

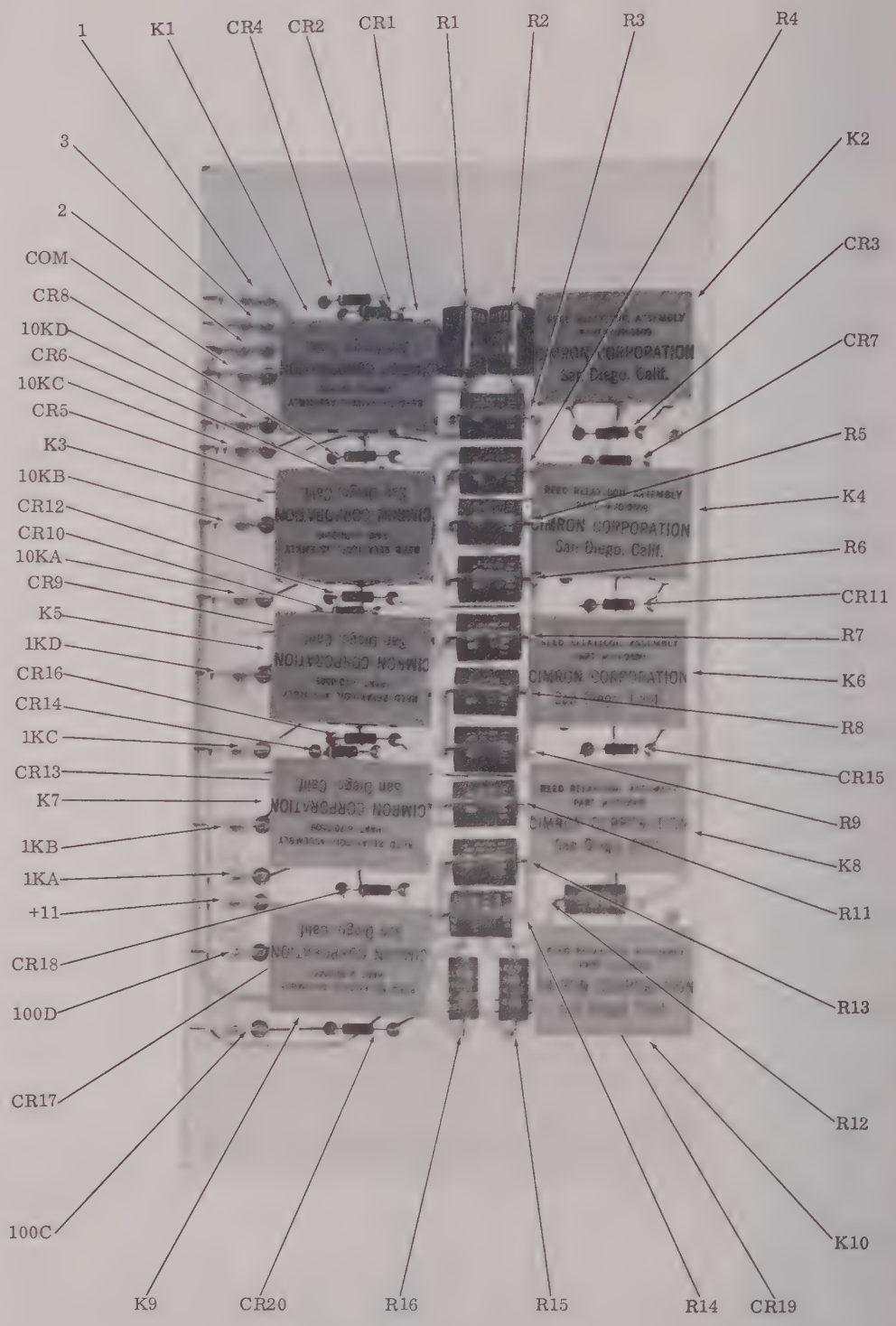
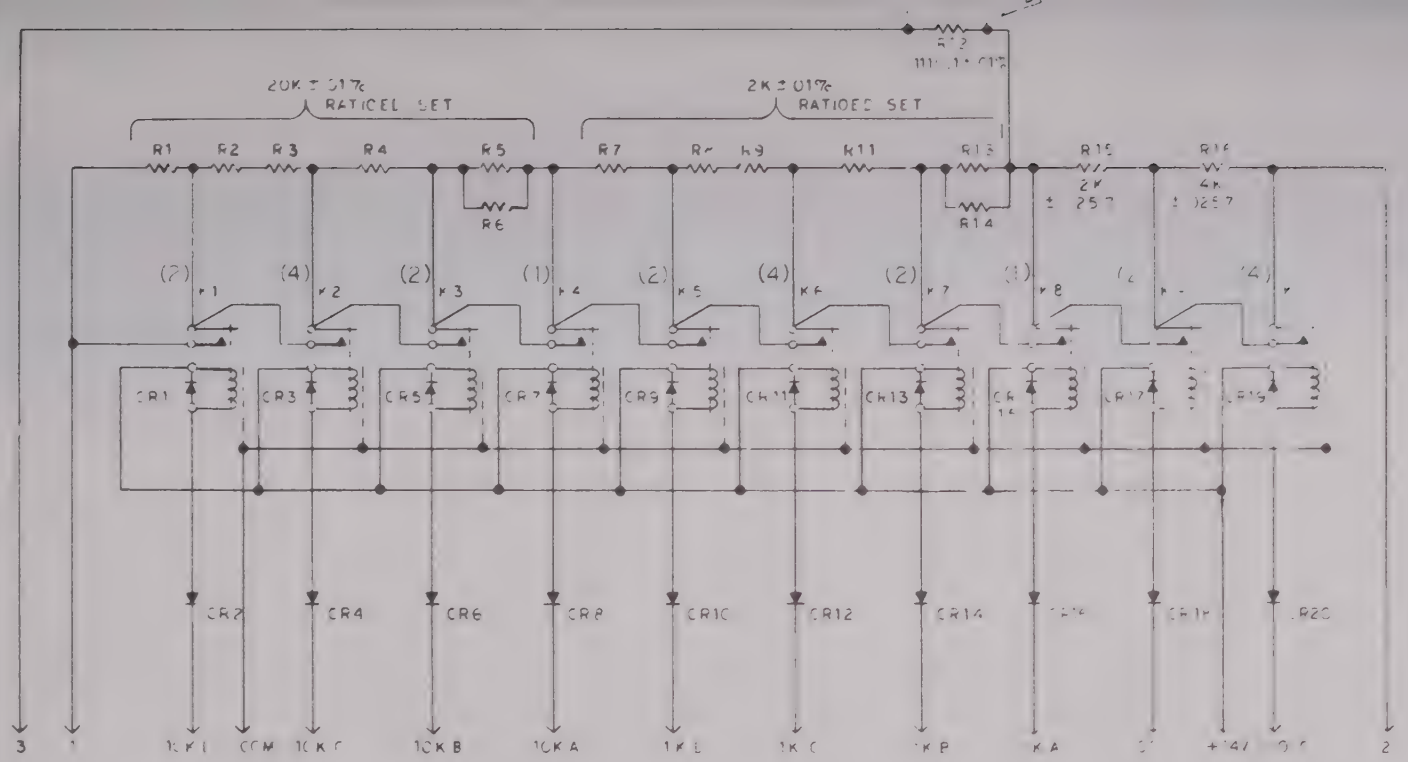


Figure 6-14. "A" Potentiometer Assembly.



NOTES ◇

1 THESE ASSEMBLIES ARE INSTALLED AS MATCHED PAIRS AND ARE NOT INDIVIDUALLY REPLACEABLE.

2. R12 USED IN 76-6019-1 ASSY ONLY
R11 IS SELECTED VALUE NOMINALLY 1Ω, 2W, WW
USED IN 76-6019-2 ASSY ONLY.

3

LAST NO USED:	NO'S NOT USED:
CR20, K10, R16.	NONE

4 ALL DIODES ARE CD-61

5 PARTIAL REFERENCE DESIGNATIONS SHOWN
FOR COMPLETE DESIGNATOR ADD 1900
EXAMPLE R1 IS R1901

MODEL
76-6C
76-6C

CHK ENG		
PROJECT		
DESIGN		
CHECK		
DRAFT	[illegible]	[illegible]

76-[illegible]719

REL DATE	
DRAWING SIZE	C

SCHEMATIC
A POTENTIO-METER
ASSY 76-6019

CIMRON

76-0719

REV

CIMRON

PARTS LIST

ASSEMBLY: "B" Potentiometer — CIMRON PART NO. 76-6020

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
RESISTOR						
R1	2 KΩ	PRECISION	0.025%	07088	OB	7-47117
R2	1 KΩ	PRECISION	0.025%	07088	OB	7-47126
R3	200Ω	PRECISION	0.05%	07088	OD	7-47112
R4	400Ω	PRECISION	0.025%	07088	OD	7-47113
R5	200Ω	PRECISION	0.05%	07088	OD	7-47112
R6	100Ω	PRECISION	0.1%	07088	OD	7-47111
R7	20Ω	PRECISION	0.5%	07088	OD	7-47109
R8	40Ω	PRECISION	0.25%	07088	OD	7-47110
R9	20Ω	PRECISION	0.5%	07088	OD	7-47109
R10	10Ω	PRECISION	1%	07088	OD	7-47108
SEMICONDUCTOR						
CR1 - CR20		*CD-61 DIODE		15318		7-95511
MISCELLANEOUS						
K1 - K10		LOW THERMAL SWITCH		15318		70-0509
		ETCHED CIRCUIT BOARD		15318		76-7020-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

NOTE:
PARTIAL REFERENCE DESIGNATIONS SHOWN. FOR COMPLETE DESIGNATOR ADD 2000. EXAMPLE: R1 is R2001

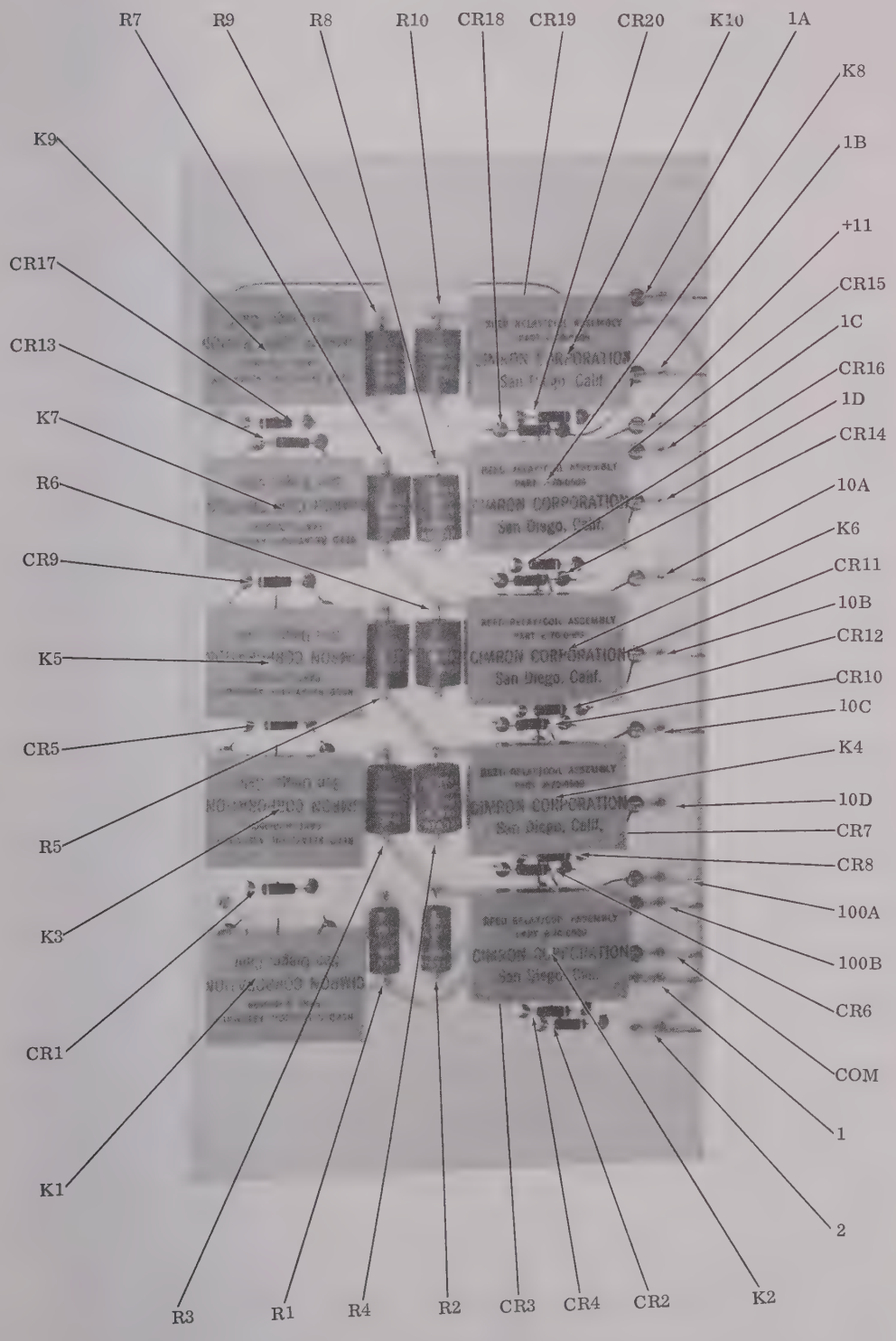
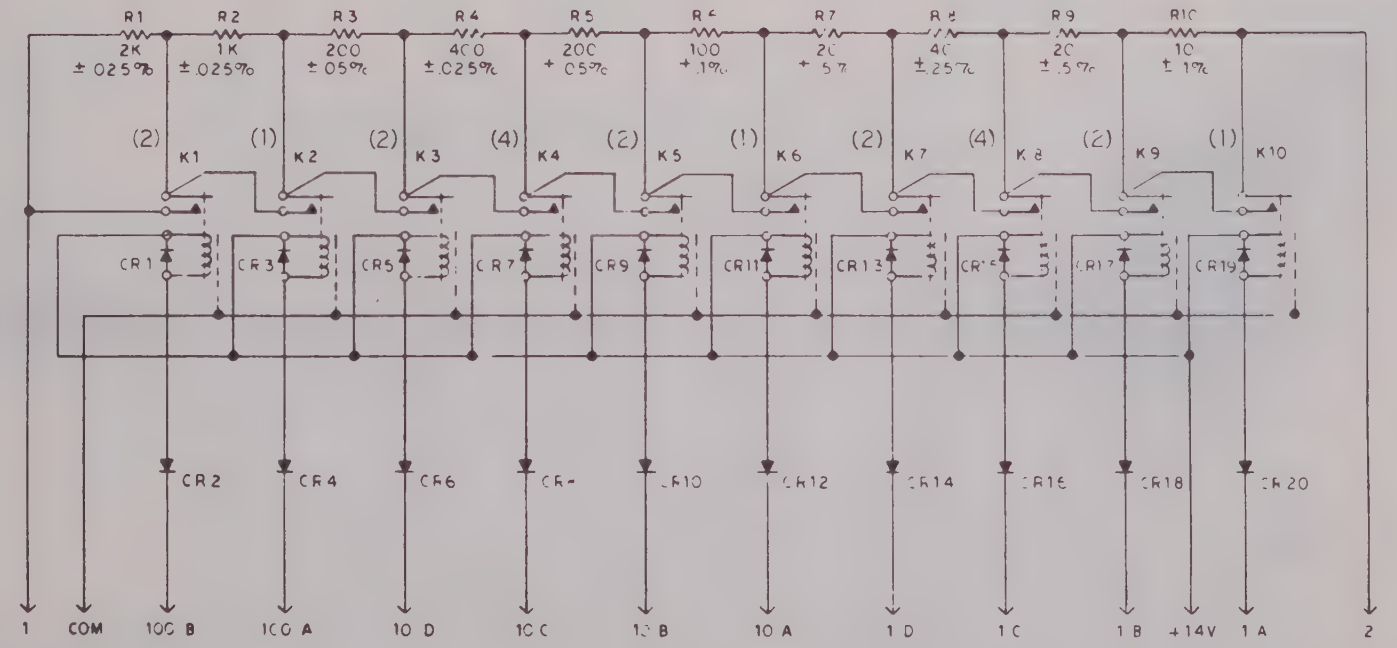


Figure 6-15. "B" Potentiometer Assembly.



NOTES ◇

1 ALL DIODES ARE CD-61.

2

LAST NO. USED:	NO'S NOT USED:
CR20, K10, R10.	NONE

3 PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 2000 EXAMPLE K1 IS K2001

MODEL
76-50
76-30
CHF ENG
PROJECT
DESIGN
CHECK
DRAFT A. CHAVEZ

76-0720

REL DATE

DRAWING SIZE C

SCHEMATIC

"B" POTENTIOMETER

ASSY 76-4020

CIMRON CORPORATION

76-0720

CIMRON

PARTS LIST

ASSEMBLY: Power Supply #1 — CIMRON PART NO. 76-6021

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1, C2	400 uf	ELECT	50V	56289	34D407H050HP4	1-57259
C3	40 uf	ELECT	250V	56289	34D406G250GL4	1-57268
C4	750 uf	ELECT	30V	56289	34D757H030HP4	1-57254
C5	20 uf	ELECT	50V	14655	NLW 20-50	1-57256
C6	10 uf	ELECT	50V	56289	TE 1304	1-57258
RESISTOR						
R1	75Ω	WW	3W 5%	56289	242E-7505	7-47150
R2	150 KΩ	COMP	1W 5%	01121	GB-1545	7-44069
R3	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
R4	2.7Ω	COMP	1W 5%	01121	GB-27G5	7-44012
R5	100Ω	COMP	1/2W 5%	01121	EB-1015	7-41031
R6	22Ω	COMP	1/2W 5%	01121	EB-2205	7-41023
R7	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
SEMICONDUCTOR						
CR1 - CR4		SC-2 DIODE		14099	SC-2	7-95502
CR5 - CR8		SC-6 DIODE		14099	SC-6	7-95504

CIMRON

PARTS LIST

ASSEMBLY: Power Supply #1 CIMRON PART NO. 76-6021

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
SEMICONDUCTOR						
CR9 - CR12		SC-2 DIODE		14099	SC-2	7-95502
CR13 - CR14		*CD-61 DIODE		15318		7-95511
CR15				JEDEC	1N717A	7-95635
CR16, CR17		*CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q1				JEDEC	2N697	9-04716
MISCELLANEOUS						
		ETCHED BOARD, CIRCUIT		15318		76-7021-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

NOTE:
PARTIAL REFERENCE DESIGNATIONS SHOWN.
FOR COMPLETE DESIGNATORS ADD 2100.
EXAMPLE: C1 is C2101.

CIMRON

PARTS LIST

ASSEMBLY: Power Supply #2 CIMRON PART NO. 76-6022

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C7, C8	400 uf	ELECT	50V	56289	34D407H050HP4	1-57259
C9	500 uf	ELECT	3V	56289	TE 1068	1-57239
C10, C11	20 uf	ELECT	50V	14655	NLW 20-50	1-57256
RESISTOR						
R8	2.7Ω	COMP	1W 5%	01121	GB-27G5	7-44012
R9, R10	1 KΩ	COMP	1/2W 5%	01121	EB-1025	7-41043
R11	100Ω	COMP	1/2W 5%	01121	EB-1015	7-41031
R12	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R14	22 KΩ	COMP	1/2W 5%	01121	EB-2235	7-41059
SEMICONDUCTOR						
CR18 - CR21		SC-2 DIODE		14099	SC-2	7-95502
CR22, CR23		*CD-61 DIODE		15318		7-95511
CR24				JEDEC	1N3030B	7-95615
CR25, CR26		*CD-61 DIODE		15318		7-95511
CR27, CR28		SC-2 DIODE		14099	SC-2	7-95502

CIMRON

PARTS LIST

ASSEMBLY: Power Supply #2 CIMRON PART NO. 76-6022

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
TRANSISTOR						
Q2				JEDEC	2N697	9-04716
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7022-1
		HEAT SINK TO-5 CLIP TYPE		02572	TR101	4-65001

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

NOTE:
PARTIAL REFERENCE DESIGNATIONS SHOWN.
FOR COMPLETE DESIGNATORS ADD 2100.
EXAMPLE: C7 is C2107.

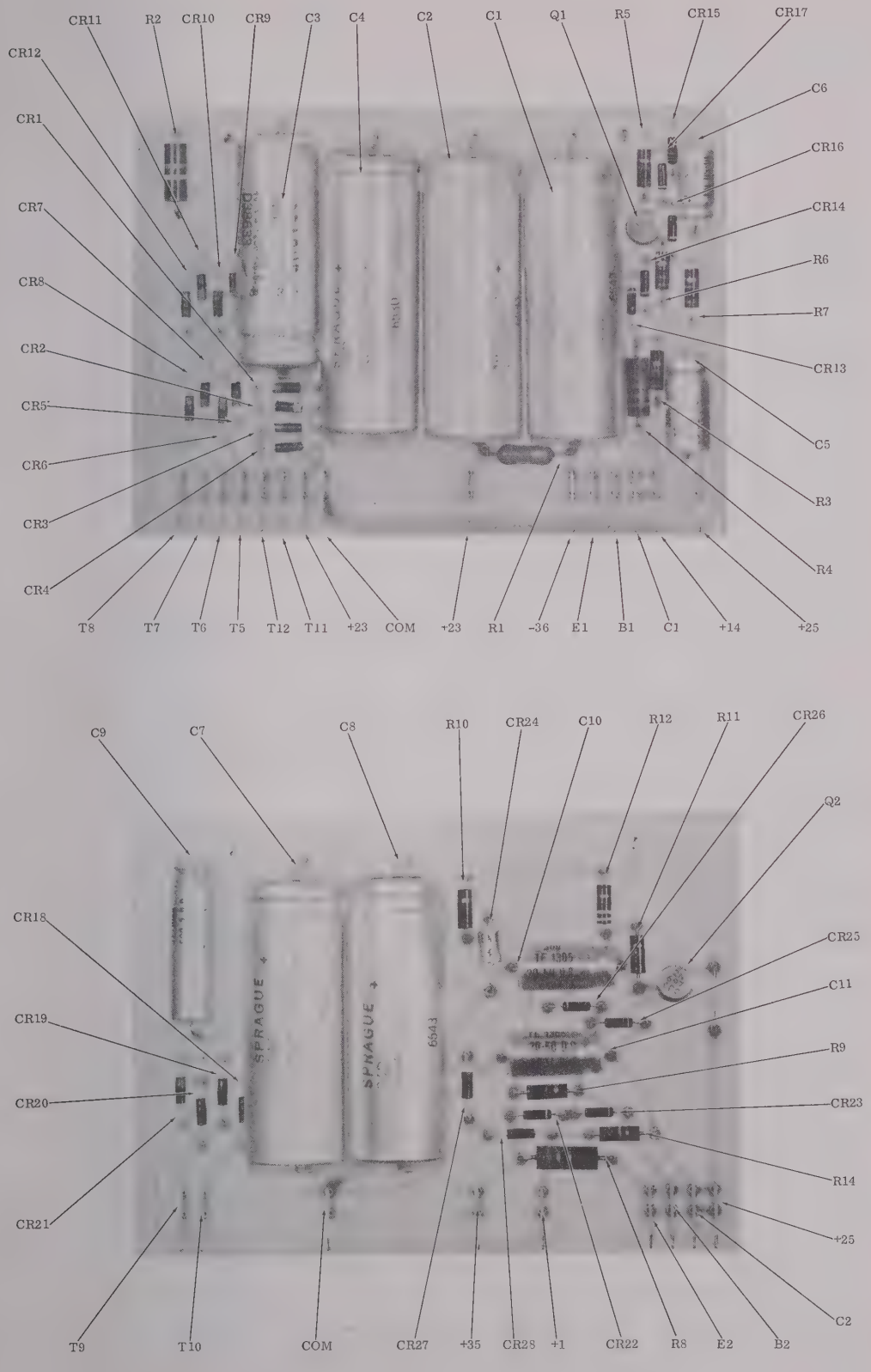
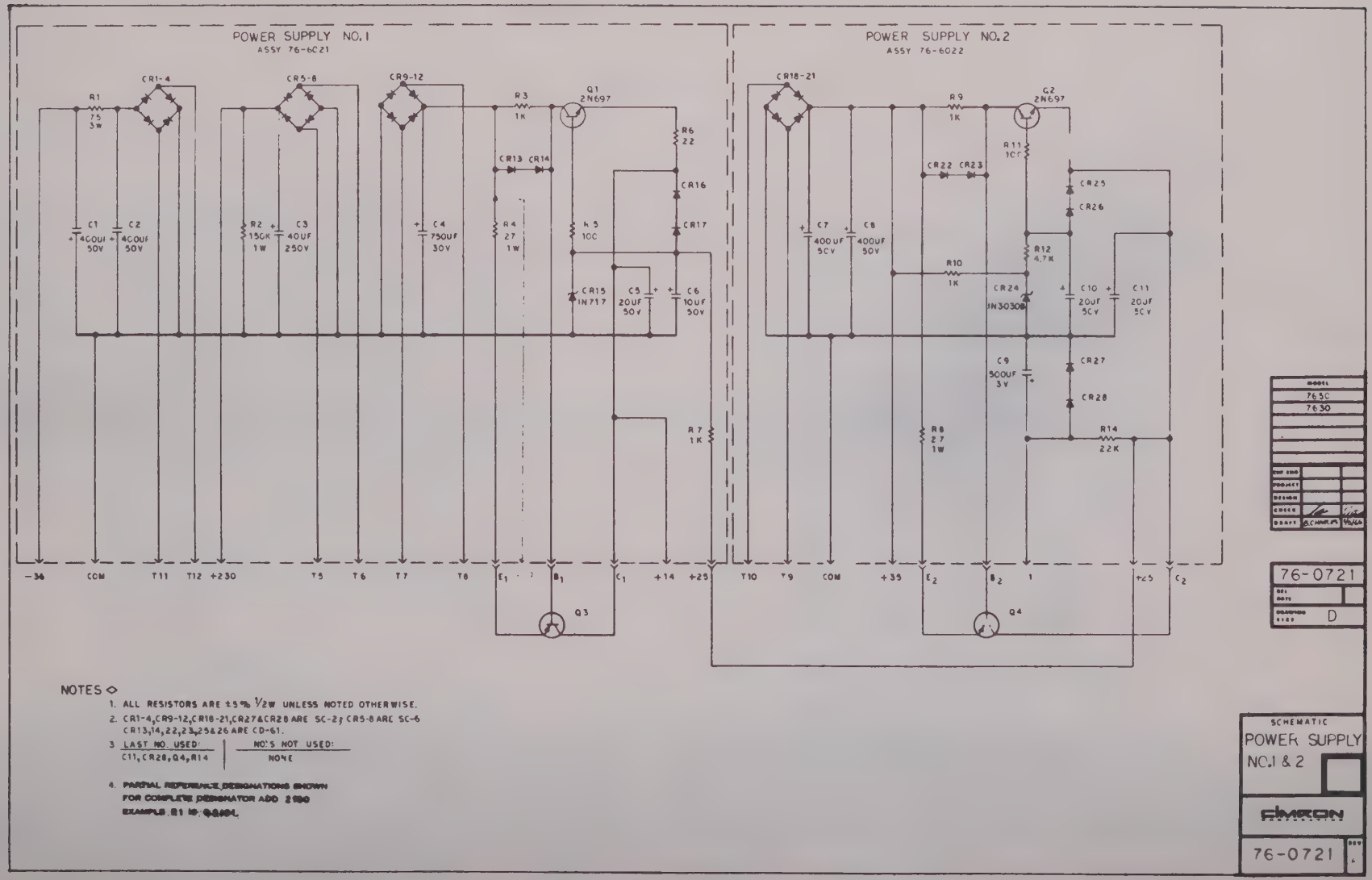


Figure 6-16. Power Supply Assemblies No. 1 and No. 2



NOTES ◇

1. ALL RESISTORS ARE ±5% 1/2W UNLESS NOTED OTHERWISE.
2. CR1-4, CR9-12, CR18-21, CR27 & CR28 ARE SC-2; CR5-8 ARE SC-6
   CR13, 14, 22, 23, 25 & 26 ARE CD-61.
3. | LAST NO. USED: | NO'S NOT USED: |
   |---|---|
   | C11, CR28, Q4, R14 | NONE |
4. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 2100 EXAMPLE: R1 IS 2100-R1.

MODEL
7650
7630

DRAFT	ACHARLES	10/6/64

76-0721

D

SCHEMATIC
POWER SUPPLY
NO. 1 & 2

CIMRON

76-0721

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R1 - R5	470 KΩ	COMP	1/2W 5%	01121	EB-4745	7-41075
R6	150 KΩ	COMP	1W 5%	01121	GB-1545	7-44069
R7	47 KΩ	COMP	1/2W 5%	01121	EB-4735	7-41063
R8	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R9	60Ω	WW	3W	04387	RS-2B	7-47158
R10	560Ω	COMP	1/2W 5%	01121	EB-5615	7-41040
SEMICONDUCTOR						
CR1 - CR4		*CD-61 DIODE		15318		7-95511
CR5 - CR31		**CD-62 DIODE		15318		7-95507
SWITCH						
S1		ROTARY, 6 POL 5 POS, FUNCTION		15318		8-64055
S2		ROTARY, 8 POL 6 POS, RANGE		15318		8-64061
S3		SLIDE, DPDT		83330	518	8-65006
S4		SLIDE, DPDT		83330	1054	8-65007
S5		SLIDE, SPST, SPRING RETURN		83330	568	8-65008
S6 (R11)	10 KΩ	RESISTOR, VAR COMP, SENSITIVITY SWITCH		15318		60-0506-3
S7		ROCKER, SPDT, POWER		15318		8-65009
S8		SLIDE, 115/230		42190	4633	8-65004

PARTS LIST

CIMRON ASSEMBLY: Master — CIMRON PART NO.

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	MANUFACTURER PART NO.	CIMRON PART NO.
TRANSISTOR						
Q3, Q4		POWER		JEDEC	2N1261	9-04610
MISCELLANEOUS						
D1 - D5		LIGHT INDICATOR NEON		03797	1B9A-6488	5-63000
D6 - D8		LAMP		15318		5-47001
DS1 - DS5		ELECTRON TUBE RECT NUMERAL		92379	B-5991	3-41407
DS6		ELECTRON TUBE RECT POLARITY		92379	B-5992	3-41406
F1		FUSE 3 AG S/B 3/4A		75915	313.750	4-08014
K1		COIL REED DRIVE		15318		70-0511-1
K1		RELAY REED		95348	MR-306-8	7-38216
T1		TRANSFORMER, POWER		15318		76-0500-1
		ANGLE BEZEL MOUNTING		15318		90-3057-1
		BAR, INSULATING		15318		76-3010-1
		BEZEL		15318		76-3029-1
		BEZEL		15318	—	11-3072-1
		BRACKET, RACK MOUNTING		15318		90-3022-3
		BRACKET, SIDE PANEL		15318		90-3058-1
		CORD, AC POWER		15318		2-70000
		COVER CASE		15318		11-3064-1

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
MISCELLANEOUS (Cont'd)						
		COVER, SIDE PANEL		15318		11-3071-1
		FUSE HOLDER		75915	342004	4-12000
		GROMMET STRAIN RELIEF		28520	SR-6P-1	4-35000
		GUIDE - ADJUSTMENT		15318		76-3022-1
		INPUT CABLE ASSY		15318		90-5004-3
		INSULATOR ASSY		15318		76-2010-1
		KNOB		15318		90-0514-1
		LAMPHOLDER		15318		5-48002
		LENSE - CLEAR		15318		5-61000
		MASTER CIRCUIT BOARD		15318		76-7000-3
		PANEL ASSY - REAR		15318		76-2003-1
		PANEL ASSY - SIDE		15318		11-2019-1
		PANEL ASSY - SUB		15318		76-2005-1
		PLATE ASSY - CONNECTOR		15318		76-2004-1
		POLARIZER		15318		76-3001-1
		POST - BINDING		83330	136	6-94005
		SHIELD - BOTTOM		15318		76-3013-3
		SHIELD - CENTER		15318		76-3003-1
		SHIELD - LH		15318		76-3004-1
		SHIELD - RH		15318		76-3002-1
		SHIELD - SWITCH		15318		76-3016-1
		SHIELD - TOP		15318		76-3012-1

PARTS LIST

CIMRON ASSEMBLY: Master CIMRON PART NO.

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
MISCELLANEOUS (Cont'd)						
		SOCKET - ELECTRON TUBE		92379	SK109	8-24002
		STRAP - TOOL HOLDER		15318		70-3005-1
		TOOL - EXTRACTION		15318		70-9500-1
		TRACK - FRONT LH		15318		76-3005-1
		TRACK - CENTER LH		15318		76-3006-1
		TRACK - FRONT RH		15318		76-3007-1
		TRACK - CENTER RH		15318		76-3008-1
		TRACK ASSY - REAR		15318		76-2009-1

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

**CD-62, I_f = 1V greater than 100 ma, I_r = 300V less than 6 ua, SILICON

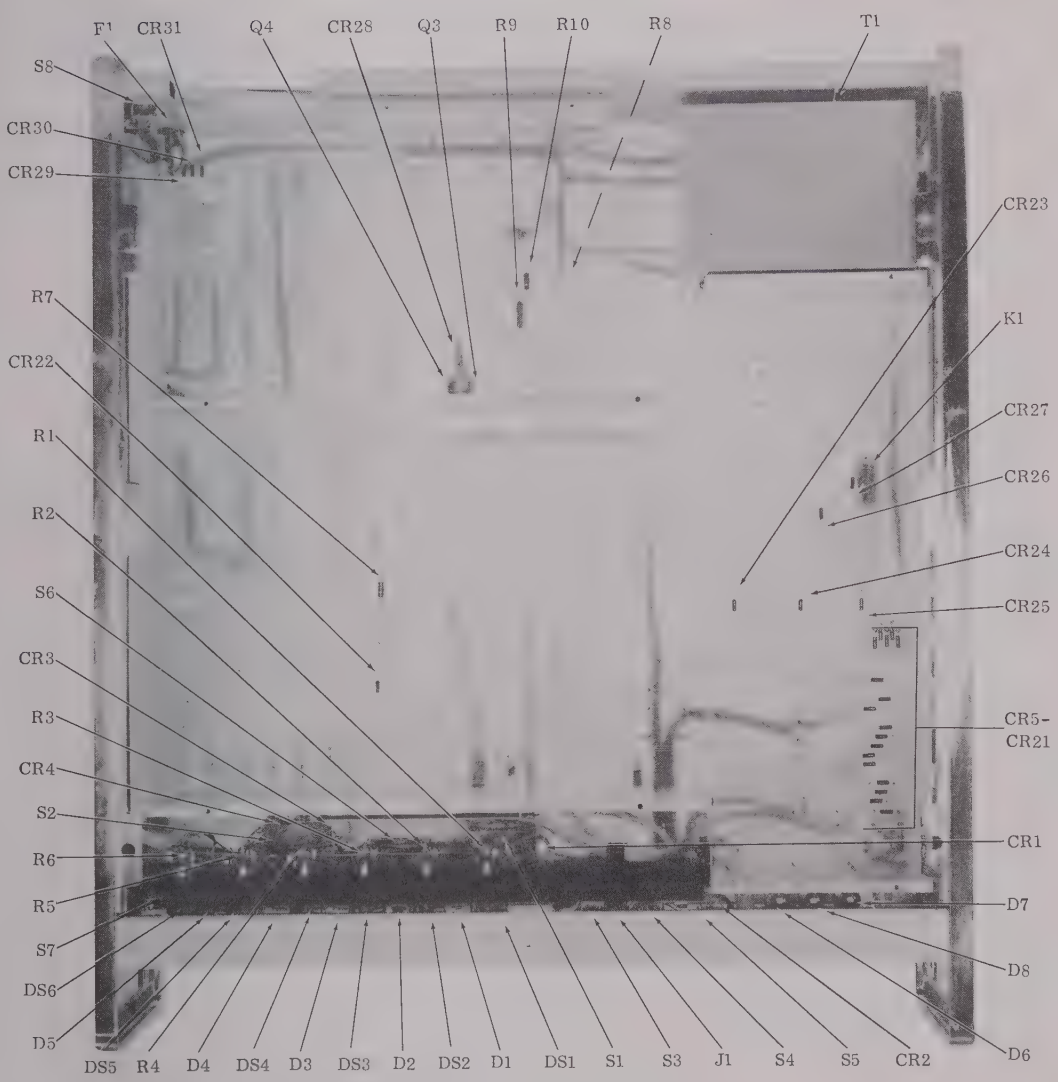


Figure 6-17. Master Assembly.

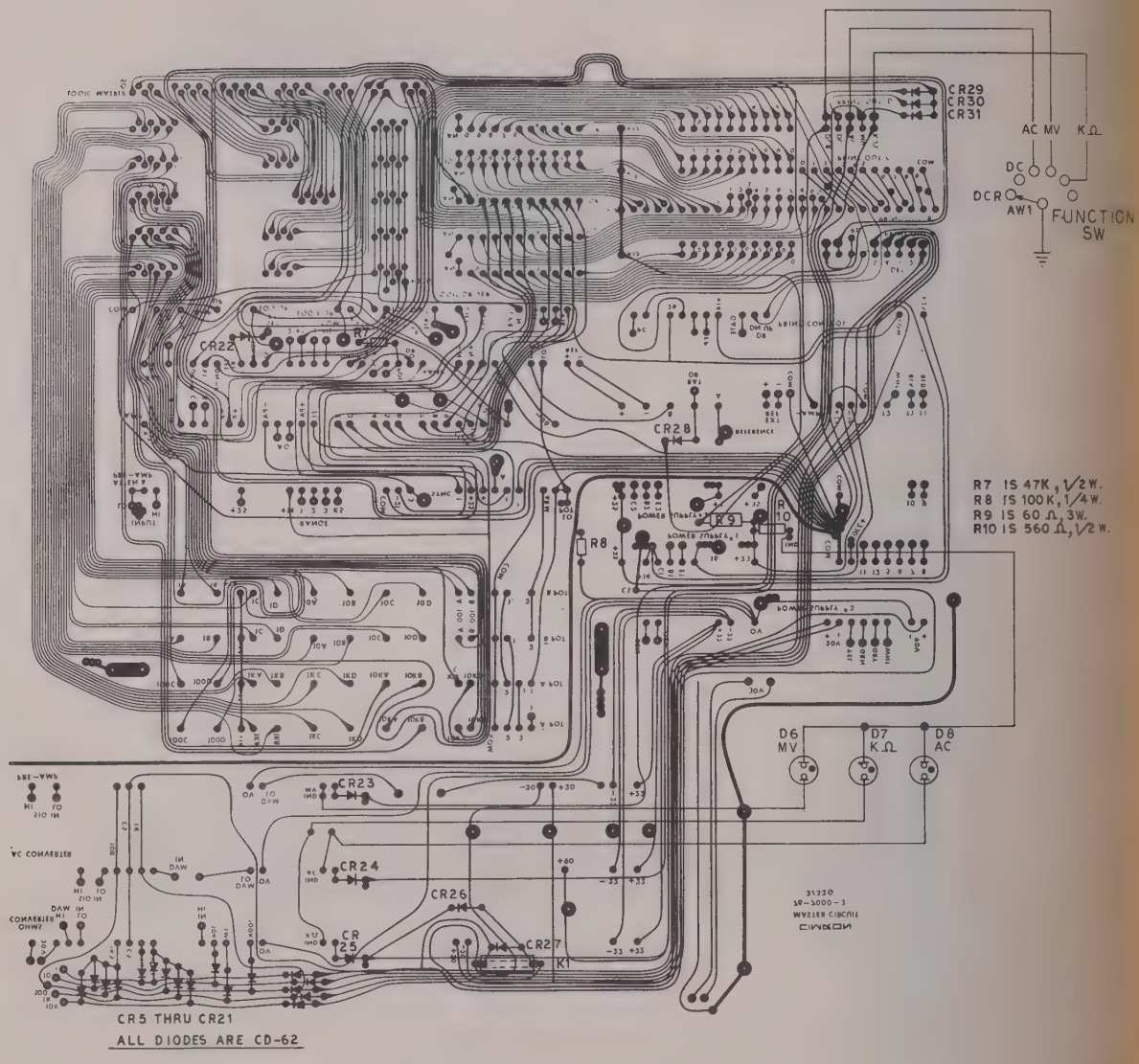
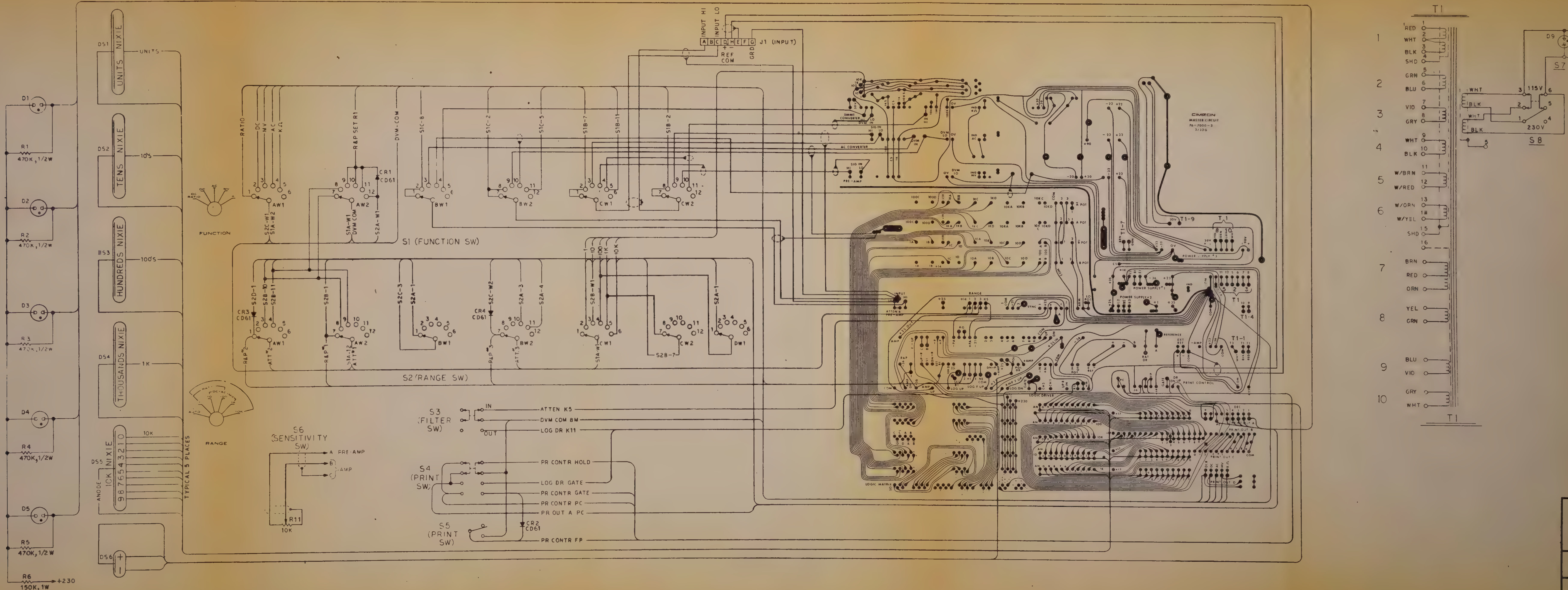


FIGURE 6-18. COMPONENTS ON MASTER ASSEMBLY.



D1
R1 470K, 1/2W
D2
R2 470K, 1/2W
D3
R3 470K, 1/2W
D4
R4 470K, 1/2W
D5
R5 470K, 1/2W
R6 150K, 1W +230
DS1 UNITS NIXIE UNITS
DS2 TENS NIXIE 10'S
DS3 HUNDREDS NIXIE 100'S
DS4 THOUSANDS NIXIE 1K
DS5 10K NIXIE 9876543210 10K
ANODE
TYPICAL 5 PLACES
DS6
FUNCTION
RANGE
RATIO
DC
MV
AC
KΩ
R&P SET R1
DVM-COM
CR1 CD61
AW1
AW2
BW1
BW2
CW1
CW2
DW1
S1 (FUNCTION SW)
S2 (RANGE SW)
CR3 CD61
CR4 CD61
INPUT HI
INPUT LO
J1 (INPUT)
REF COM
GRD
S3 (FILTER SW)
IN
OUT
ATTEN K5
DVM COM BM
LOG DR K11
S4 (PRINT SW)
PR CONTR HOLD
LOG DR GATE
PR CONTR GATE
PR CONTR PC
PR OUT A PC
S5 (PRINT SW)
CR2 CD61
PR CONTR FP
S6 (SENSITIVITY SW)
A PRE-AMP
B
C
AMP
R11 10K
CIMRON MASTER CIRCUIT 76-7000-3
POWER SUPPLY #1
POWER SUPPLY #2
LOGIC MATRIX
LOGIC DRIVER
PRINT CONTROL
PRINT OUT A
PRINT OUT B
PRINT OUT C
PRINT OUT D
T1-9
T1-7
T1-4
T1-1
T1
RED
WHT
BLK
SHD
GRN
BLU
VIO
GRY
W/BRN
W/RED
W/ORN
W/YEL
BRN
ORN
YEL
D9
ON
OFF
F1
S7
115V
230V
S8

ESS OTHERWISE SPECIFIED
. RESISTORS ARE ±5% 1/4W.
. CAPACITORS ARE IN μF.
RTIAL REFERENCE DESIGNATIONS SHOWN.
R COMPLETE DESIGNATOR ADD 0000.
AMPLE R1 IS R0001.

ST NUMBER USED	NUMBERS NOT USED
1, DS6, R11, S8, J1, D9, F1, K1.	NONE

MODEL
7650

CHF ENG		
PROJECT		
DESIGN		
CHECK		
DRAFT	B CHARLES	

76-0700
REL DATE 4/12/66 B
DRAWING SIZE R

A REV ECN #1628
B REV ECN #1663

SCHEMATIC
MASTER
WIRING

CIMRON

76-0700
SHEET 1 OF 2
SHEET 2 IS DIAG. 6-18 B

SECTION VII

RECOMMENDED SPARE PARTS

The following is a list of the recommended spare parts required to maintain a specific number of instruments at a satisfactory level of performance for one year in an isolated area.

TABLE VII

Recommended Spare Parts.

ASSEMBLY OR PART NAME	ASSEMBLY OR P/N	QUANTITY OF PARTS		
		1 Instru.	5 Instru.	10 Instru.
Attenuator and Pre-Amp	76-6016	1	3	5
Amplifier	76-6013	1	3	5
Logic Driver	76-6012	1	3	5
Logic Matrix	76-6017	1	3	5
Range and Polarity	76-6014	1	3	5
10K Decade	76-6011	1	3	5
Units Through 1K Decade	76-6018	2	6	10
Power Supply 1	76-6021	1	3	5
Power Supply 2	76-6022	1	3	5
A Potentiometer Set	76-6019	1	3	5
B Potentiometer Set	76-6020	1	3	5
Reference and Ratio	76-6024	1	3	5
Print Control, Model 7650 only	76-6023	1	3	5
Print Output A, Model 7650 only	76-6008	1	3	5
Print Output B, Model 7650 only	76-6009	1	3	5
Print Output C, Model 7650 only	76-6010	1	3	5
Print Output D, Model 7650 only	76-6007	1	3	5

Continued on page 7-2.

TABLE VII (Cont'd)

Recommended Spare Parts.

ASSEMBLY OR PART NAME	ASSEMBLY OR P/N	QUANTITY OF PARTS		
		1 Instru.	5 Instru.	10 Instru.
AC Converter Plug-in Accessory	6770	1	3	5
DC Preamplifier Plug-in Accessory	6880	1	3	5
Ohms Converter Plug-in Accessory	6990	1	3	5
Power Supply Plug-in Accessory	985	1	3	5
Tool, Extraction	90-9500-1	1	3	5
Fuse, 3AG, S-B, 1/2A	4-08013	5	5	10
Fuse Holder	4-12000	1	3	5
Input Cable	90-5004-3	1	2	3

NOTE

The extension boards recommended below are not a functional part of the instrument. They are designed primarily as an aid in troubleshooting. The extension board is placed between a suspected plug-in board and its mating connector in the instrument. The suspected board is thus raised above the surface of the instrument permitting easy access to components and test points.

TABLE VIII

Test and Extension Board Assemblies.

ASSEMBLY OR PART NAME	ASSEMBLY OR P/N	QUANTITY OF PARTS		
		1 Instru.	5 Instru.	10 Instru.
Extension Board 12"	76-9501-1	1	2	4
Extension Board 8"	76-9502-1	1	2	4
Extension Board 5.75"	76-9503-1	1	2	4
Logic Tester Assembly	76-9504-1	1	1	1

SECTION VIII
PLUG-IN ACCESSORIES

GENERAL

There are four plug-in accessories available for use with the Series 7600 Digital Multimeter. They are:

Model 985 Power Supply Plug-In Accessory
Model 6880 DC Preamplifier Plug-In Accessory
Model 6770 AC Converter Plug-In Accessory
Model 6990 Ohms Converter Plug-In Accessory

The Model 985 Power Supply Plug-In Accessory is required as a power source for any or all of the other three plug-in accessories.

Provisions are made in the Series 7600 multimeter for inserting the power supply plug-in accessory and any combination of the other plug-in accessories, as shown in figure 8-1.

SECTION VIII SUBSECTIONS

Information pertaining to calibration and specification validation procedures, theory of operation, maintenance instructions, parts lists, component location, and schematic diagrams for each plug-in accessory are contained in separate subsections of this section.

Each subsection has been prepared separately for insertion in the Series 7600 Instruction Manual as required. When any of the plug-in accessories are shipped with the basic multimeter, the appropriate subsections are inserted in the basic instruction manual at the factory prior to shipment. When any of the plug-in

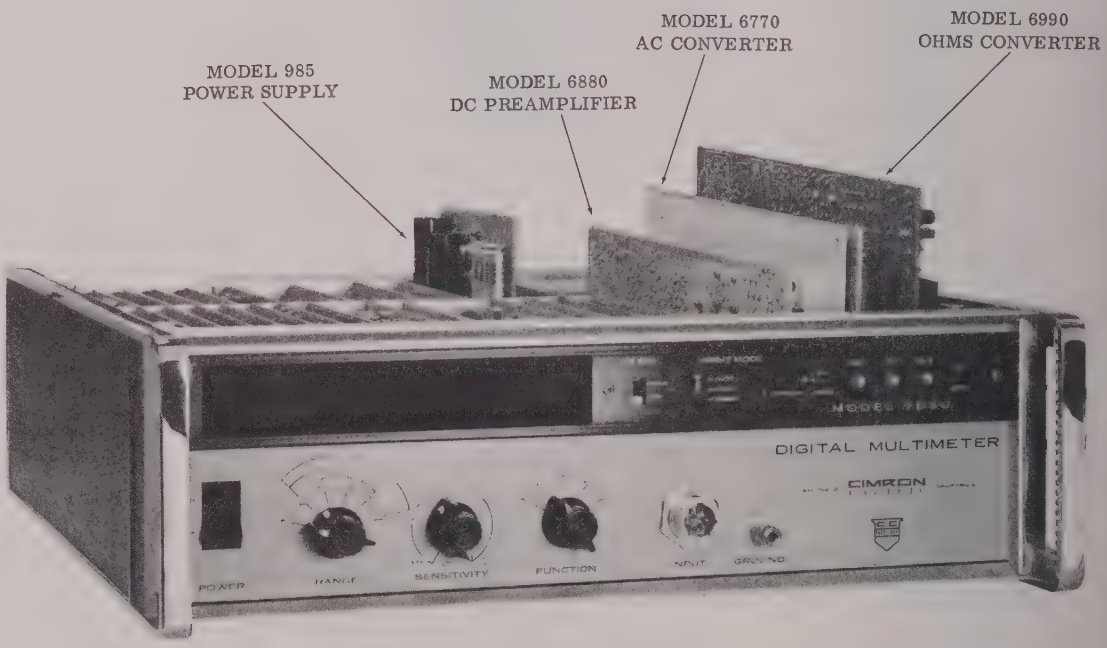


Figure 8-1. Series 7600 Digital Multimeter Plug-In Accessories.

accessories are ordered at a later date, the appropriate subsections are shipped with the equipment and may be inserted in the basic instruction manual upon receipt.

The Section VIII subsections and the plug-in accessories to which they apply are:

Section VIII-A	Model 985 Power Supply
Section VIII-B	Model 6880 DC Preamplifier
Section VIII-C	Model 6770 AC Converter
Section VIII-D	Model 6990 Ohms Converter

PRELIMINARY INSTRUCTIONS

Prior to performing the operational checkout of the power supply plug-in accessory and the calibration and specification validation procedures for the other plug-in accessories, ensure that:

1. The plug-in accessories are firmly seated in the multimeter and have been allowed the same environmental temperature stabilizing time and warmup time required for the multimeter, as described in Section IV.

2. The multimeter operational checkout, described in Section III, and the calibration and specification validation procedures, described in Section IV, have been performed.

NOTE

The calibration and specification validation procedures for the plug-in accessories must be performed in the order indicated.

All adjustments should be made with a non-metallic alignment tool.

SECTION VIII-A

MODEL 985 POWER SUPPLY PLUG-IN ACCESSORY

(PART NO. 76-6004)

OPERATIONAL CHECKOUT

The power supply is designed to supply DC voltage, with the indicated tolerances and ripple voltage values, as follows:

+22V ±10% at 80 mA maximum
Ripple: Less than 10 mV peak-to-peak

-22V ±10% at 52 mA maximum
Ripple: Less than 10 mV peak-to-peak

20V ±20% at 35 mA maximum
Ripple: Approximately 3V peak-to-peak

90V (-15V, +5V) at 7 mA maximum
Ripple: Approximately 125 mV peak-to-peak

The following special equipment is required in performing the power supply operational checkout:

1. Tektronix Model 502 oscilloscope or equivalent

2. A 60 cps AC source with a variable output from at least 100V to 130V RMS

Perform the power supply operational checkout as follows:

1. Position the multimeter POWER switch to OFF.

2. Position the multimeter FUNCTION switch to AC, MV, or KΩ, depending on which plug-in accessories are available, and the RANGE switch to 100.

3. Insert a CIMRON extender board (Part No. 76-9503-1) in the multimeter and mount the power supply plug-in accessory on the extender board.

4. Connect the test setup as indicated in figure 8A-1.

5. Adjust the oscilloscope as follows:

    a. TRIGGERING LEVEL to AUTOMATIC

    b. TRIGGER INPUT to LINE

    c. TIME/CM to 5 mSEC

    d. UPPER BEAM to AC-A

    e. HORIZONTAL DISPLAY to NORMAL

    f. SENSITIVITY control to 1 mV per centimeter

    g. 1-to-1 probe into upper beam A

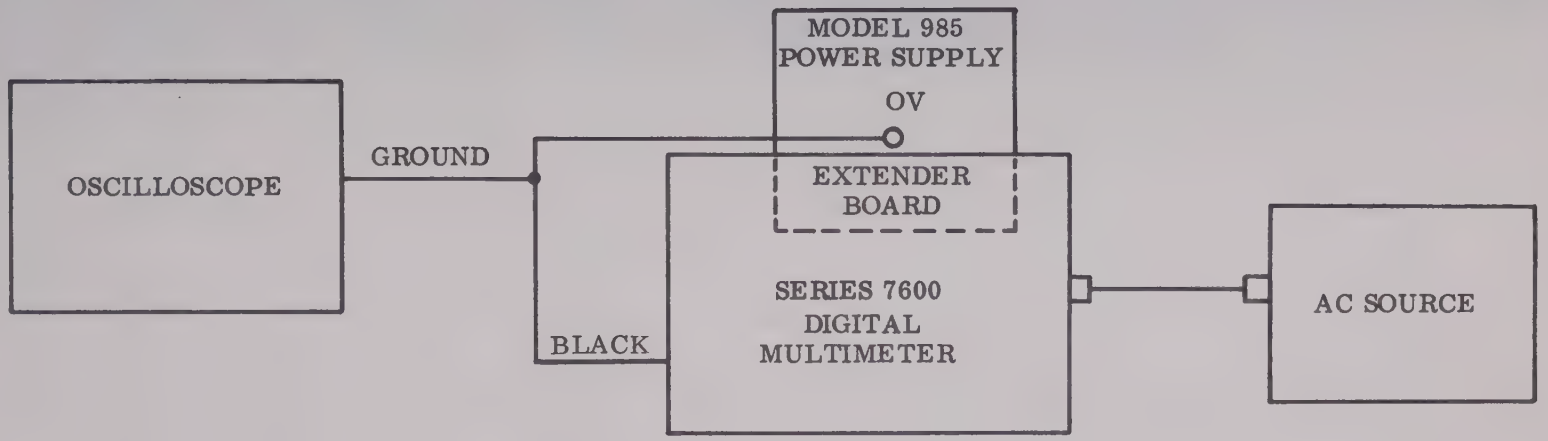


Figure 8A-1. Power Supply Operational Checkout Test Setup.

6. Adjust the AC power source for 130V output.

7. Connect the oscilloscope 1-to-1 probe and the multimeter red lead to the +22 terminal of the plug-in power supply (figure 8A-2).

NOTE

When power is first applied to the multimeter during the operational checkout, allow a 15 minute warm-up period before proceeding to the next step. For subsequent applications of power, allow a one minute warm-up period.

8. Position the multimeter POWER switch to ON.

9. Observe a multimeter indication of 22V ±10% and an oscilloscope indication of less than 10 mV peak-to-peak.

10. Adjust the AC power source for 115V output.

11. Repeat step 9.

12. Adjust the AC power source for 100V output.

13. Repeat step 9.

14. Position the multimeter POWER switch to OFF.

15. Connect the oscilloscope 1-to-1 probe and the multimeter red lead to the -22 terminal of the plug-in power supply (figure 8A-2).

16. Position the multimeter POWER switch to ON.

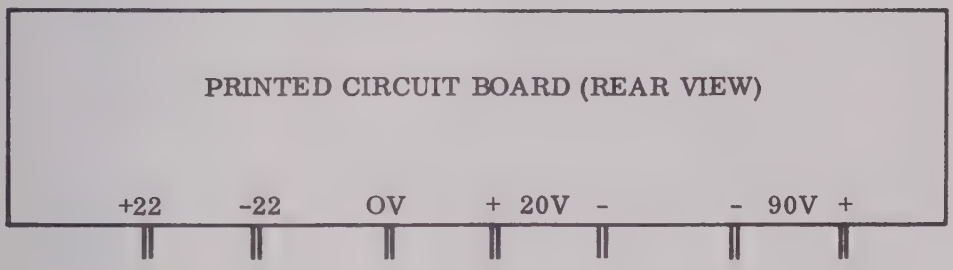


Figure 8A-2. Model 985 Power Supply Plug-In Accessory Output Voltage Terminals.

17. Observe a multimeter indication of 22V ±10% and an oscilloscope indication of less than 10 mV peak-to-peak.

18. Adjust the AC power source for 115V output.

19. Repeat step 17.

20. Adjust the AC power source for 130V output.

21. Repeat step 17.

22. Position the multimeter POWER switch to OFF.

23. Adjust the oscilloscope sensitivity to 1V per centimeter.

24. Connect the oscilloscope 1-to-1 probe and the multimeter red lead to the -20V terminal of the plug-in power supply (figure 8A-2).

25. Position the multimeter POWER switch to ON.

26. Observe a multimeter indication of 20V ±20% and an oscilloscope indication of approximately 3V peak-to-peak.

27. Adjust the AC power source for 115V output.

28. Repeat step 26.

29. Adjust the AC power source for 100V output.

30. Repeat step 26.

31. Position the multimeter POWER switch to OFF.

32. Adjust the oscilloscope sensitivity to 20 mV per centimeter.

33. Connect the oscilloscope 1-to-1 probe and the multimeter red lead to the +90V terminal of the plug-in power supply (figure 8A-2).

34. Position the multimeter POWER switch to ON.

35. Observe a multimeter indication of 75V to 95V and an oscilloscope indication of approximately 125 mV peak-to-peak.

36. Adjust the AC power source for 115V output.

37. Repeat step 35.

38. Adjust the AC power source for 130V output.

39. Repeat step 35.

40. Position the multimeter POWER switch to OFF.

41. Disconnect the test setup.

42. Remove the extender board and insert the plug-in power supply in the multimeter.

THEORY OF OPERATION

GENERAL

The power supply supplies operating voltages to the Model 6880 DC Preamplifier, Model 6770 AC Converter, and Model 6990 Ohms Converter Plug-In Accessories. All of the associated plug-in accessories are supplied with regulated plus and minus 22 volts. The DC preamplifier and the ohms converter are also supplied with -20 volts and the AC converter with +90 volts.

The AC inputs to the power supply full-wave rectifiers are taken from secondary windings of the multimeter power transformer T1.

CIRCUIT DESCRIPTION

The power supply, shown in schematic diagram 76-0704 at the back of this section, consists of a regulated 22-volt section, a 20-volt section, and a 90-volt section.

REGULATED 22-VOLT SECTION

The full-wave rectifier consists of diodes CR1 through CR4. The positive output of the rectifier is filtered by capacitors C1 and C5 and is regulated by a series regulating circuit consisting of diode CR13 and transistors Q1, Q2, and Q5. An error voltage is sensed in Q2 by comparison of a portion of the positive output voltage with 12-volt reference diode CR13. The amplified error voltage forms the input to regulating element Q1 and Q5. The +22V DC output from the emitter of Q5 develops a controlling voltage of 4.7 volts across diode CR14. The controlling voltage is applied to the junction of the Q2 collector and Q1 base through resistor R10. The negative output of the rectifier is filtered by capacitors C2 and C6 and is regulated by a series regulating circuit consisting of transistors Q3, Q4, and Q6. An error voltage is sensed in Q3 by comparison of a portion of the +22V DC output and the -22V DC output with circuit common. The amplified error voltage forms the input to regulating element Q4 and Q6. The -22V DC output from the emitter of Q6 develops a controlling voltage of 4.7 volts across diode CR15. The controlling voltage is applied to the junction of the Q3 collector and Q4 base through resistor R11. Resistors R19 and R20 are the 22-volt bleeder resistors.

20-VOLT SECTION

The full-wave rectifier consists of diodes CR5 through CR8. The output of the rectifier is filtered by capacitors C3 and C7. Resistor R12 is the bleeder resistor.

90-VOLT SECTION

The full-wave rectifier consists of diodes CR9 through CR12. The output of the rectifier is filtered by capacitors C4 and C8. Resistor R13 is the bleeder resistor.

MAINTENANCE

TROUBLESHOOTING

All components of the power supply are mounted on a single plug-in circuit board. Troubleshooting is accomplished by replacing the circuit board. When a new circuit board is inserted, the operational checkout for the power supply should be made.

REPAIR

A faulty circuit board may be repaired or sent to the factory for repair. When replacing components on a circuit board, extreme care must be taken to prevent damage from excessive heat. A low wattage soldering iron is recommended and, whenever possible, a heat sink should be used. A parts list, an illustrated components location (figure 8A-3), and a schematic diagram of the power supply are provided in this section to facilitate repair.

CIMRON

PARTS LIST

ASSEMBLY: Power Supply — CIMRON PART NO. 76-6004

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1, C2	50 uf	ELECT	50V 85°C	14655	BR 50-50	1-57210
C3	250 uf	ELECT	25V	56289	TVA1208	1-57280
C4	10 uf	ELECT	150V 85°C	14655	NLW 10-150	1-57264
C5, C6	50 uf	ELECT	50V 85°C	14655	BR 50-50	1-57210
C8	40 uf	ELECT	150V 85°C	56289	TVA 1413	1-57265
C9	2.2 uf	TANT	35V 20%	01295	SCM225BP035D4	1-57104
C10	0.01 uf	MET PAP	50V 10%	12406	VX5A103K	1-57323
C11	2.2 uf	TANT	35V 20%	01295	SCM225BP035D4	1-57104
RESISTOR						
R1, R2	47Ω	COMP	1/2W 5%	01121	EB-4705	7-41027
R3	27Ω	COMP	1/2W 5%	01121	EB-2705	7-41024
R4	100Ω	COMP	1/4W 5%	01121	CB-1015	7-41231
R5	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R6	3.9 KΩ	COMP	1/4W 5%	01121	CB-3925	7-41250
R7	33Ω	COMP	1/2W 5%	01121	EB-3305	7-41025
R8	100Ω	COMP	1/2W 5%	01121	EB-1015	7-41031
R9 - R11	3.9 KΩ	COMP	1/4W 5%	01121	CB-3925	7-41250

CIMRON

PARTS LIST

ASSEMBLY: Power Supply — CIMRON PART NO. 76-6004

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R12	27 KΩ	COMP	1/2W 5%	01121	EB-2735	7-41060
R13	100 KΩ	COMP	1/2W 5%	01121	EB-1045	7-41067
R14, R15	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R16	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R17	4.75 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46500
R18	15 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46517
R19	22.1 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46506
R20	21.5 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46527
SEMICONDUCTOR						
CR1 - CR12		DIODE		14099	SC-2	7-95502
CR13		ZENER DIODE		JEDEC	1N719	7-95610
CR14, CR15		ZENER DIODE		JEDEC	1N750	7-95608
TRANSISTOR						
Q1, Q2		CT-26 or 2N2222		15318		9-04710
Q3, Q4				JEDEC	2N3638	9-04722
Q5				49671	40250	9-04723

CIMRON

PARTS LIST

ASSEMBLY: Power Supply — CIMRON PART NO. 76-6004

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
TRANSISTOR						
Q6				JEDEC	2N3740	9-04802
MISCELLANEOUS						
		ETCHED CIRCUIT BOARD		15318		76-7004-1

NOTE:
PARTIAL REFERENCE DESIGNATIONS SHOWN.
FOR COMPLETE DESIGNATORS ADD 400.
EXAMPLE: R1 is R401

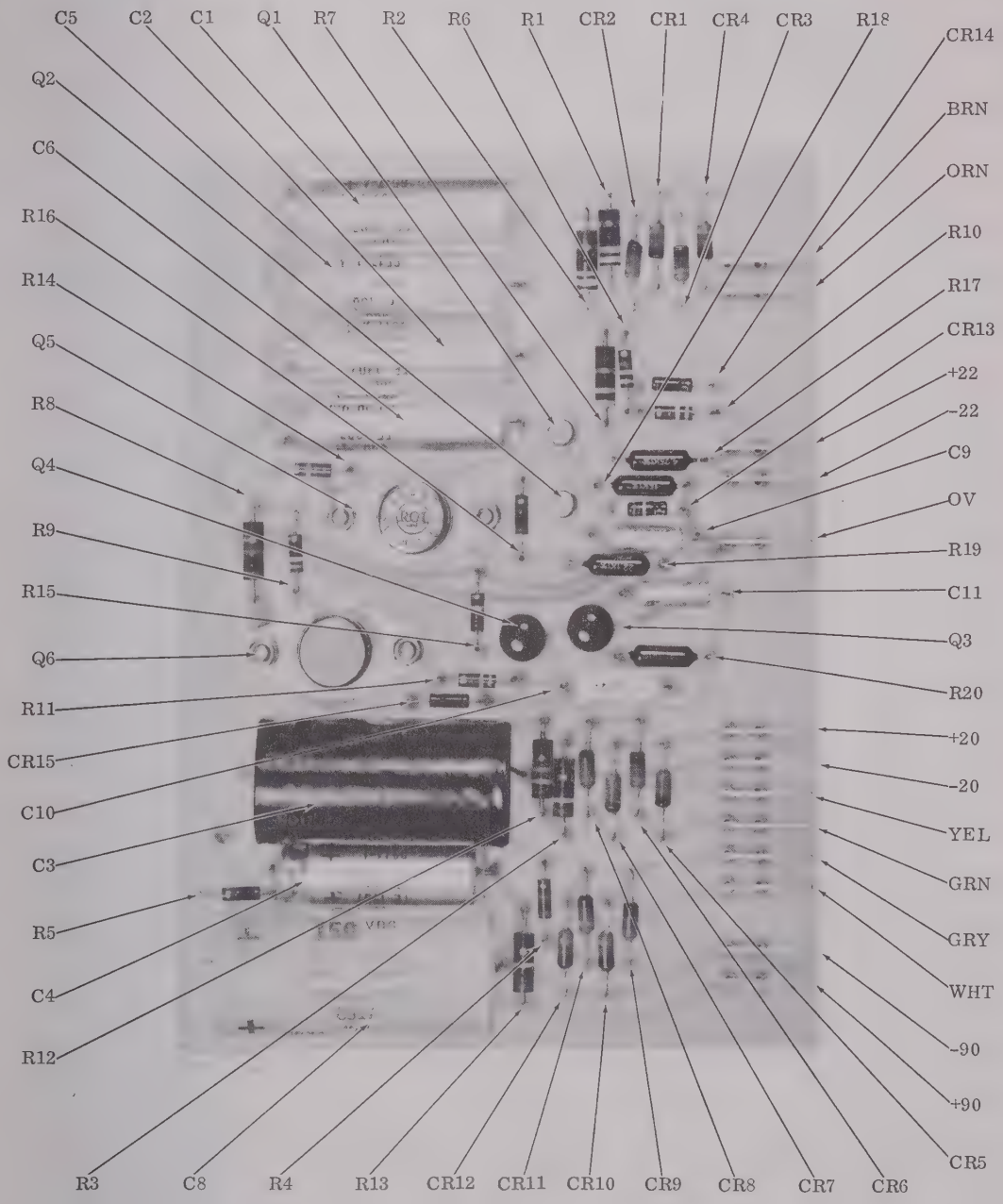
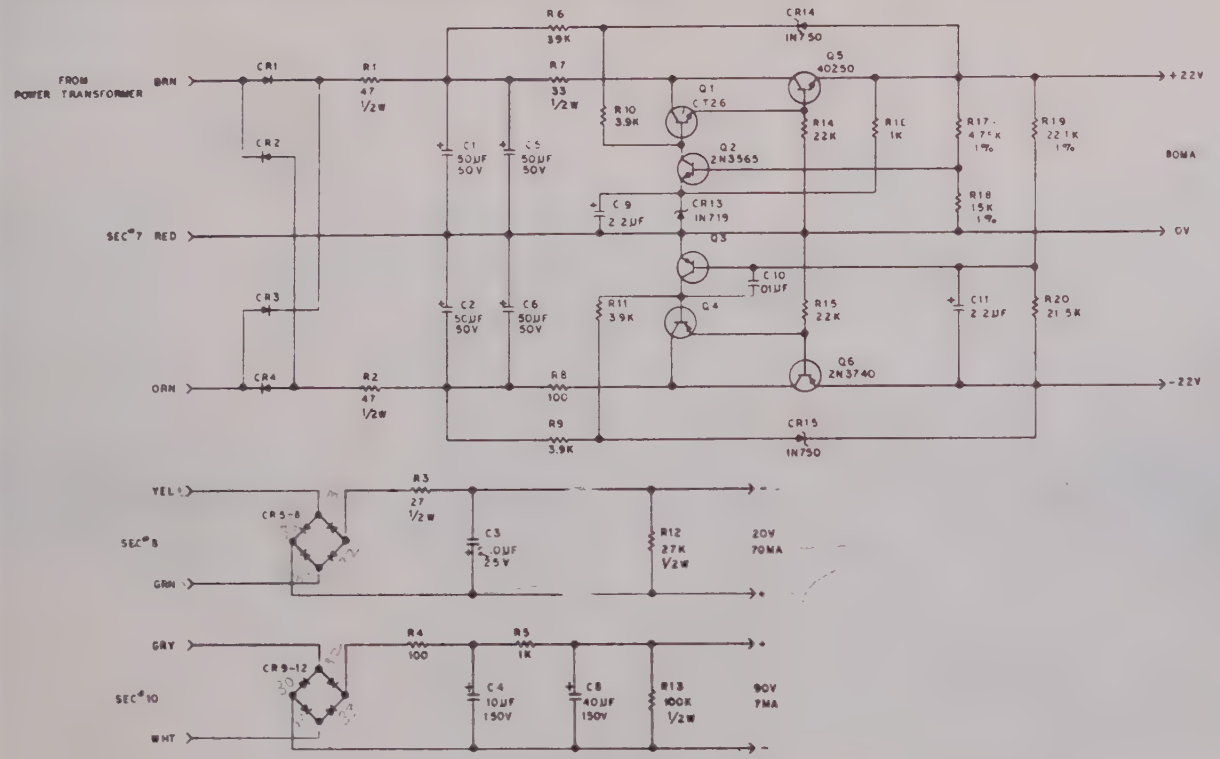


Figure 8A-3. Model 985 Power Supply Plug-In Accessory



NOTES ◇

1. ALL RESISTOR ARE 5%, 1/4W UNLESS NOTED OTHERWISE
2. Q3&Q4 ARE 2N3638
3. CR1 THRU 12 ARE SC-2
5. LAST NO USED: C11, CR15, Q6, R20 | NO'S NOT USED: C7
6. PARTIAL REFERENCE DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR ADD 400 EXAMPLE R1 = R 401.

76-0704

D

SCHEMATIC
POWER SUPPLY NO. 3
ASSY 76-6004

CIMRON

76-0704

SECTION VIII-B

MODEL 6880 DC PREAMPLIFIER PLUG-IN ACCESSORY

(PART NO. 68-6016)

OPERATIONAL CHECKOUT AND CALIBRATION

ZERO AND DC BALANCE ADJUSTMENT

A Tektronix Model 502 oscilloscope or equivalent is required in performing the zero and DC balance adjustment.

Perform the zero and DC balance adjustment procedure as follows:

1. Remove the multimeter top outer cover and top shield.
2. Position the multimeter FUNCTION switch to MV and the RANGE switch to 10.
3. Connect the multimeter red and black leads together.
4. Connect the oscilloscope between TP1 and GD (Figure 8B-1).
5. Set the oscilloscope to internal DC trigger and the vertical input to AC coupled.

NOTE

When making the following adjustments, allow for compensation of internal offsets and thermal voltage. After making an adjustment, wait one minute before readjusting.

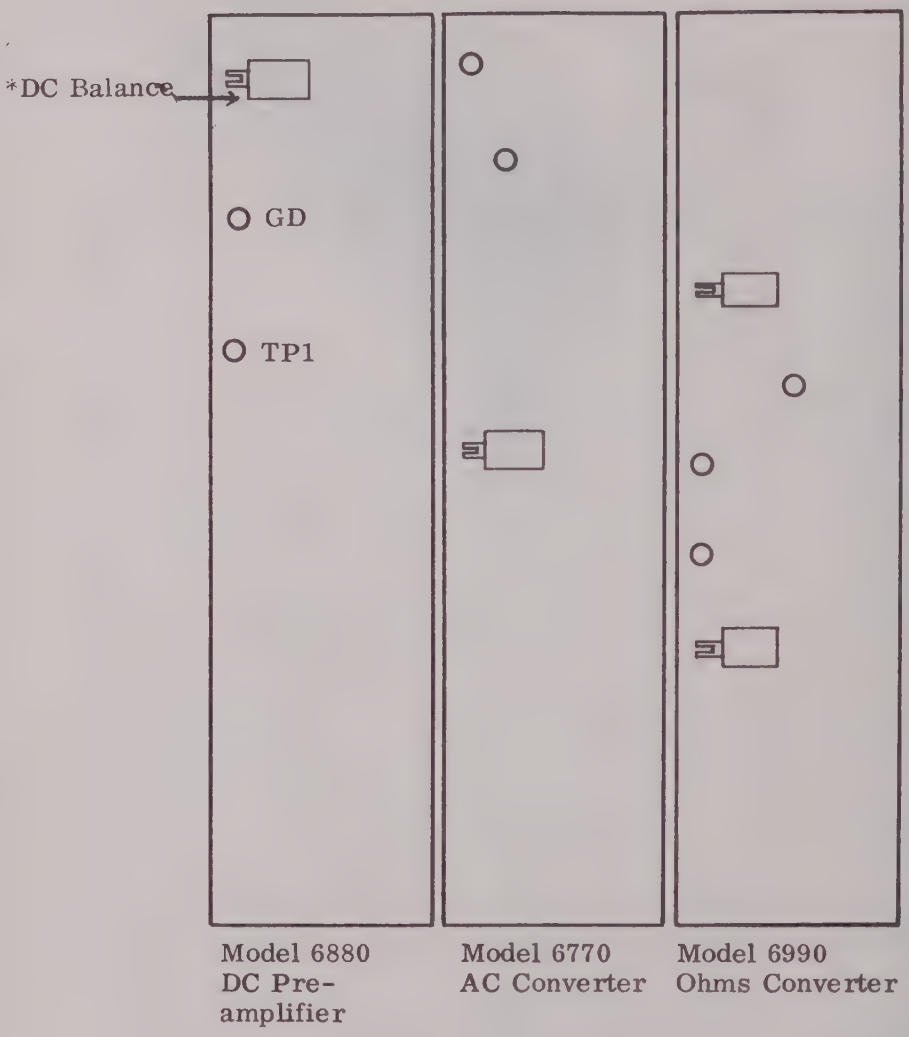


Figure 8B-1. DC Preamplifier Plug-in Accessory Balance Adjustments (front view).

*The words "DC Balance" do not appear on the printed circuit board.

6. Vary the DC balance adjustment (figure 8B-1) to eliminate positive and negative excursions of the square wave (figure 8B-2). Positive and negative noise spikes on the oscilloscope indication are caused by DC preamplifier chopper operation and may be disregarded.

7. Adjust the multimeter front panel MV ZERO adjustment for an indication on the multimeter of 0.0000.

8. Repeat steps 6 and 7 as necessary until there are no positive and negative excursions of the square wave and the multimeter indicates 0.0000.

RANGE CALIBRATION

One precision, stable, calibrated DC power supply, variable in 10 mV increments, with an accuracy of at least 0.01%, and capable of supplying 9.5000 mV, 99.500 mV, and 999.50 mV is required in performing the range calibration procedure.

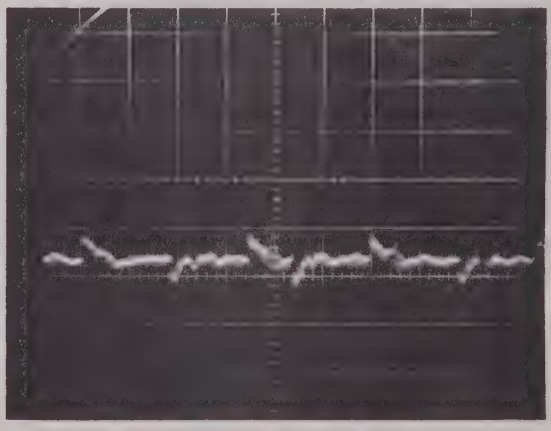
Perform the range calibration procedure as follows:

1. Replace the top shield of the multimeter and position the multimeter FUNCTION switch to MV and the RANGE switch to 10.

2. Connect the DC power supply to the multimeter (figure 4-5) and adjust the output of the DC power supply to 9.5000 mV.

3. Vary the 10 MV adjustment (figure 4-3) to obtain a multimeter indication of 9.5000 mV.

Positive and Negative Excursions



Properly Adjusted

Figure 8B-2. Oscilloscope Indication.

4. Position the multimeter RANGE switch to 100 and adjust the output of the DC power supply to 99.500 mV.

5. Vary the 100 MV adjustment (figure 4-3) to obtain a multimeter indication of 99.500 mV.

6. Position the multimeter RANGE switch to 1K and adjust the output of the DC power supply to 999.50 mV.

7. Vary the 1 KMV adjustment (figure 4-3) to obtain a multimeter indication of 999.50 mV.

SPECIFICATIONS VALIDATION

The following special equipment is required in performing specification validation procedures:

1. Precision, stable, calibrated DC power supply with an accuracy of at least 0.01% and capable of supplying 9.9950 mV, 99.950 mV, and 999.50 mV

2. Precision, calibrated voltage divider with a total resistance of 10 KΩ

3. Ohmmeter

4. Single-pole-single-throw switch

5. Mercury cell, 1.34V

6. Wideband audio oscillator

7. Resistor, 1 MΩ, 1%, 1/4 watt

8. Resistors, 1/2 watt, 10Ω, 800Ω, and 10 KΩ

ACCURACY

Perform the accuracy validation procedure as follows:

1. Connect the test setup as indicated in figure 4-5.

2. Position the multimeter FUNCTION switch to MV and the RANGE switch to 10.

3. Adjust the DC power supply for an output of 9.9950 mV and observe that the multimeter indication is 9.9950 mV ±3 microvolts.

4. Position the multimeter RANGE switch to 100.

5. Adjust the DC power supply for an output of 99.950 mV and observe that the multimeter indication is 99.950 ±20 microvolts.

6. Position the multimeter RANGE switch to 1K.

7. Adjust the DC power supply for an output of 999.50 mV and observe that the multimeter indication is 999.50 mV ±0.2 mV.

INPUT RESISTANCE

The input resistance of the DC preamplifier is validated by measuring the voltage drop across a resistor in series with an external voltage input to the multimeter.

Perform the input resistance validation procedure as follows:

1. Connect the test setup as indicated in figure 4-6, omitting the 1 microfarad capacitor.

2. Position the multimeter FUNCTION switch to MV and the RANGE switch to 10.

3. Adjust the output of the DC power supply to 10V.

4. Close S1 and adjust the output of the voltage divider for a multimeter indication of 999.95 mV.

5. Open switch S1 and note the multimeter indication. This is the voltage drop across the DC preamplifier input, E_m.

6. Close switch S1 and observe that the multimeter indication is the same as in step 4.

7. Compute the DC preamplifier input resistance as follows:

   a. The voltage drop across the external resistor, ΔE, is the indication in step 4 minus the indication in step 5.

   b. Input current $= \frac{\Delta E}{10^6}$

   c. DC preamplifier input resistance $= \frac{E_m}{\text{Input Current}}$

COMMON MODE REJECTION

The following procedure is used for both AC and DC common mode rejection validation. The AC common mode voltage source is 60 cps from an audio

oscillator. The DC common mode voltage source is a DC power supply. If the common mode voltage is E_{cm} and the least significant digit change of the multimeter indication is defined as the error voltage E_e, the common mode voltage rejection ratio is expressed in decibels by the following formula:

$$\text{Common Mode Rejection} = 20 \log \frac{E_{cm}}{E_e}$$

Perform the common mode rejection validation procedure as follows:

1. With the multimeter POWER switch positioned to ON, measure the resistance between signal LO (multimeter black lead) and chassis ground (GROUND terminal on the multimeter front panel). The measurement must indicate infinity. Correct any short or leakage between signal LO and chassis ground before proceeding to the next step.

2. Connect the test setup as indicated in figure 8B-3.

3. Adjust the output of the common mode voltage source to 0 volt and observe the multimeter indication.

4. Slowly increase the output of the common mode voltage source until the least significant digit of the multimeter indication becomes unstable.

5. Determine the common mode rejection ratio of the multimeter in accordance with Table 8B-I.

THEORY OF OPERATION

GENERAL

The DC preamplifier extends the low range of the multimeter to the microvolt level.

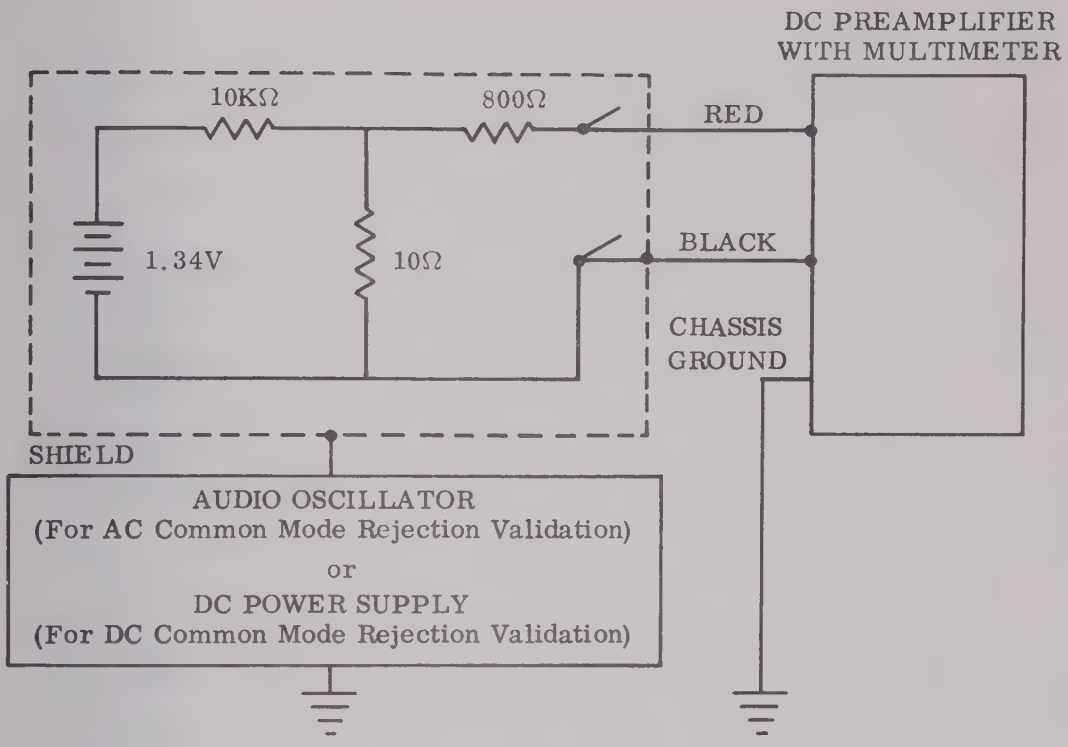


Figure 8B-3. Common Mode Rejection Validation Setup.

TABLE 8B-I.

Common Mode Rejection Ratio $\frac{E_{cm}}{E_e}$ in dB.

E_e / *E_{cm}	0.1mV	0.01mV	0.001mV	0.0001mV
1V	80 dB	100 dB	120 dB	140 dB
5V	94 dB	114 dB	134 dB	154 dB
10V	100 dB	120 dB	140 dB	160 dB
50V	114 dB	134 dB	154 dB	174 dB
100V	120 dB	140 dB	160 dB	180 dB
500V	134 dB	154 dB	174 dB	194 dB

*E_{cm} is given in volts DC or volts peak-to-peak AC.

The voltage being measured is applied to the DC preamplifier, filtered, converted to AC and amplified, demodulated and amplified again, and then applied through a range attenuation network to the DC section of the multimeter where it is measured.

The DC preamplifier has three basic ranges, ±000.01 to ±999.99 millivolts full scale, ±00.001 to ±99.999 millivolts full scale, and ±0.0001 to ±9.9999 millivolts full scale. The DC preamplifier output is 10 volts full scale in all ranges.

In all ranges, with the multimeter FUNCTION switch positioned to MV, the unknown voltage to be measured is applied through the INPUT HI and INPUT LO segments of the function switch to the DC preamplifier.

The output of the DC preamplifier is applied through the OUTPUT HI and OUTPUT LO segments of the multimeter FUNCTION switch to the attenuator and pre-amp assembly of the multimeter.

CIRCUIT DESCRIPTION

The DC preamplifier (schematic diagram 68-0716 contained in this subsection) consists of an input, carrier amplifier, demodulator, output amplifier, attenuator, and an oscillator. Power is obtained from the Model 985 Power Supply Plug-In Accessory described in Section VIII-A.

INPUT

The input portion consists of IN HI and IN LO terminals, neon bulb DS1, chopper G1, capacitors C4, C6, C7, and C10, resistors R2, R5, R7 and R11, diodes CR1 and CR2, and the primary winding of coupling transformer T1.

The input voltage is applied from the IN HI terminal across the three-section RC filter R2 and C4, R5 and C6, and R7 and C7. The output of the filter is applied

to the reed of chopper G1 through R11. The chopper converts the DC input voltage to a square wave of approximately 450 cps which is connected to the primary winding of coupling transformer T1. The centertap of the primary winding is used as a summing junction for gain control feedback voltage. Neon bulb DS1 protects the input in the event a high voltage is applied to the input of the DC amplifier. Diodes CR1 and CR2 are voltage protective devices for the reed of chopper G1.

CARRIER AMPLIFIER

The carrier amplifier portion consists of the secondary winding of transformer T1, three differential amplifier pair transistors Q4 and Q5, Q6 and Q7, and Q8 and Q9, and the primary winding of coupling transformer T2.

The secondary winding of T1 drives the bases of the first differential amplifier pair, Q4 and Q5. The collector outputs of Q4 and Q5 are applied to the bases of Q6 and Q7 respectively, the second differential amplifier pair. Feedback is taken from the output of the second differential amplifier and applied to the first differential amplifier. The collector output of Q6 is applied to the emitter of Q4 through R26 and R35. The collector output of Q7 is applied to the emitter of Q5 through R34 and R40. Capacitors C13 and C15 filter the feedback voltages. The collector outputs of Q6 and Q7 drive the bases of Q8 and Q9 respectively, the third differential amplifier pair. Transistors Q8 and Q9 drive the primary winding of demodulator transformer T2. Diodes CR7 and CR8 and resistors R42 and R45 provide decoupling for the plus and minus 22 volt inputs. Capacitors C16 and C17 provide filtering action. Potentiometer R44 is the multimeter front panel MV ZERO adjustment. R44 applies feedback voltage to the summing junction centertap of the primary winding of transformer T1, thereby providing high DC gain stability for the carrier amplifier portion. The gain of the carrier amplifier portion is approximately 80 dB.

DEMODULATOR

The demodulator portion consists of the secondary winding of transformer T2 and complementary pair clamping transistors Q10 and Q11.

Transistors Q10 and Q11 demodulate the AC output of the carrier amplifier portion. The transistors alternately clamp opposite terminals of the secondary winding of T2 to common. A DC path is provided from common through the center-tap on the secondary winding of T2 to the input of the output amplifier portion. The clamping action is synchronized with chopper G1 in the input portion and controlled by the oscillator that drives chopper G1.

OUTPUT AMPLIFIER

The output amplifier portion consists of differential amplifier pair transistors Q12 and Q14, constant current source Q13, amplifier Q15, emitter follower Q16, and a complementary emitter follower pair Q17 and Q18.

The output amplifier portion is an integrating amplifier. The demodulated signal from the demodulator portion is applied to differential amplifier pair Q12 and Q14 at the base of Q12. Transistor Q13 is a constant current source for Q12. Potentiometer R56 is the DC balance adjustment. Q14 acts like a grounded base amplifier driving the base of collector-loaded amplifier Q15. Capacitors C21 and C22 provide roll-off for the collectors of Q12 and Q14 respectively. Diode CR9 provides reference voltage for the emitters of Q13 and Q15. The collector output of Q15 drives the base of emitter follower Q16. Diodes CR10 and CR11 establish bias requirements for the bases of the complementary emitter follower pair Q17 and Q18. The emitter outputs of Q17 and Q18 are applied to capacitors C19 and C20, and to the summing junction centertap on the primary winding of transformer T1 through the attenuator portion. Capacitors C19 and C20 provide integrating feedback to the base of Q12. The voltage applied to the summing junction through the attenuator portion determines the range of the DC preamplifier. The output of the DC preamplifier is taken from the HI FUNCTION SW and the LO FUNCTION SW terminals. The gain of the output amplifier portion is approximately 60 dB.

ATTENUATOR

The attenuator portion consists of relays K1 and K2, resistors R13, R17, R21, and R22, and potentiometers R14, R18, and R23.

The overall gain of the DC preamplifier is established by the attenuator portion, which controls the amount of feedback applied to the primary winding centertap of transformer T1. The range of the attenuator is controlled by the multimeter RANGE switch. With the RANGE switch in the 10 position, the contacts of relays K1 and K2 are open. With the RANGE switch in the 100 position, K1 contacts are open and K2 contacts are closed. With the RANGE switch in the 1K position, K1 contacts are closed and K2 contacts are open. Potentiometers R14, R18, and R23 are the range calibration adjustments.

OSCILLATOR

The oscillator portion consists of astable multivibrator transistors Q2 and Q3 and demodulator driver Q1.

The astable multivibrator drives chopper G1 and demodulator driver Q1 at a frequency of approximately 450 cps. Demodulator driver Q1 drives the bases of clamping transistors Q10 and Q11, in the demodulator portion, through capacitor C3.

MAINTENANCE

TROUBLESHOOTING

All the components of the DC preamplifier are mounted on a single plug-in circuit board. Troubleshooting is accomplished by replacing the circuit board.

When a new circuit board is inserted, the calibration and specification validation procedures for the DC preamplifier should be performed.

REPAIR

A faulty circuit board may be repaired or sent to the factory for repair. When replacing components on a circuit board, extreme care must be taken to prevent damage from excessive heat. A low wattage soldering iron is recommended and, whenever possible, a heat sink should be used. A parts list, an illustrated component location (figure 8B-4), and a schematic diagram of the DC preamplifier are provided in this section to facilitate repair.

CIMRON

PARTS LIST

ASSEMBLY: DC Preamplifier — CIMRON PART NO. 68-6016

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C1	0.1 uf	MET PAP	50V 10%	12406	VX5A104K	1-57321
C2	100 uf	ELECT	25V	14655	NLW 100-25	1-57253
C3	0.22 uf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C4	0.47 uf	POLY STY	100V 10%	12406	PD1A474K	1-57362
C5	100 uf	ELECT	25V	14655	NLW 100-25	1-57253
C6	0.47 uf	POLY STY	100V 10%	12406	PD1A474K	1-57362
C7	1 uf	POLY STY	100V 10%	12406	PD1A105K	1-57361
C8, C9	0.22 uf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C10	68 nf	MET PAP	50V 10%	12406	VX5A683K	1-57322
C11, C12	0.15 uf	MET PAP	50V 10%	12406	VX5A154K	1-57320
C13	6 uf	ELECT	15V 85°	14655	NLW 6-15	1-57245
C14	3.3 nf	MET PAP	200V 10%	11837	215B1C332K2	1-57352
C15	6 uf	ELECT	15V 85°	14655	NLW 6-15	1-57245
C16, C17	47 uf	TANT	35V 20%	02567	CS13AF470M	1-57107
C18	0.22 uf	MET PAP	50V 10%	12406	VX5A224K	1-57319
C19, C20	5 uf	MET MY	100V 20%	12406	E-1241	1-57304
C21, C22	3.3 nf	MET PAP	200V 10%	11837	215B1C332K2	1-57352

CIMRON

PARTS LIST

ASSEMBLY: DC Preamplifier — CIMRON PART NO. 68-6016

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
CAPACITOR						
C23	1.8 mf	CER DISC	1000V 10%	71590	DD-182	1-57503
RESISTOR						
R1	27Ω	COMP	1/4W 5%	01121	CB-2705	7-41224
R2	4.7 KΩ	WW	3W 3%	04887	RS-3B	7-47171
R3	120Ω	COMP	1/4W 5%	01121	CB-1215	7-41232
R4	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R5	4.7 KΩ	COMP	1/2W 5%	01121	EB-4725	7-41051
R6	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R7	2.2 KΩ	COMP	1/4W 5%	01121	CB-2225	7-41247
R8	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R9	100 KΩ	COMP	1/4W 5%	01121	CB-1045	7-41267
R10	5.6 KΩ	COMP	1/4W 5%	01121	CB-5625	7-41252
R11	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R12	560Ω	COMP	1/2W 5%	01121	EB-5615	7-41040
R13	9.065 KΩ	WW	1/4W 0.1%	07088	1368-P	7-47222
R14	50Ω	VAR TRIM WW		09145	114-500	7-54219
R15, R16	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255

CIMRON

PARTS LIST

ASSEMBLY: DC Preamplifier — CIMRON PART NO. 68-6016

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R17	109.7 KΩ	WW	1/4W 0.1%	07088	1368-P	7-47224
R18	500Ω	VAR TRIM WW		80294	275-1-501	7-54206
R19, R20	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R21	900Ω	WW	1/4W 0.1%	07088	1368-P	7-47221
R22	99.8 KΩ	WW	1/4W 0.1%	07088	1368-P	7-47223
R23	500Ω	VAR TRIM WW		80294	275-1-501	7-54206
R24	100Ω	WW	1/4W 0.1%	07088	1368-P	7-47220
R25	560Ω	COMP	1/2W 5%	01121	EB-5615	7-41040
R26	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R27	10 MΩ	COMP	1/4W 5%	01121	CB-1065	7-41291
R28	33.2 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46514
R29	470Ω	COMP	1/4W 5%	01121	CB-4715	7-41239
R30	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R31	33 KΩ	COMP	1/4W 5%	01121	CB-3335	7-41261
R32	33.2 KΩ	DEP CARB	1/8W 1%	00656	CPM	7-46514
R33	470Ω	COMP	1/4W 5%	01121	CB-4715	7-41239
R34 - R36	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255

CIMRON

PARTS LIST

ASSEMBLY: DC Preamplifier — CIMRON PART NO. 68-6016

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R37	220Ω	COMP	1/4W 5%	01121	CB-2215	7-41235
R38	4.7 KΩ	COMP	1/4W 5%	01121	CB-4725	7-41251
R39	220Ω	COMP	1/4W 5%	01121	CB-2215	7-41235
R40, R41	10 KΩ	COMP	1/4W 5%	01121	CB-1035	7-41255
R42	1.2 KΩ	COMP	1/4W 5%	01121	CB-1225	7-41244
R43	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R44	20 KΩ	VAR TRIM WW		80294	200P-1-203	7-54203
R45	1.2 KΩ	COMP	1/4W 5%	01121	CB-1225	7-41244
R46, R47	1.5 KΩ	COMP	1/4W 5%	01121	CB-1525	7-41245
R48	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R49	220Ω	COMP	1/4W 5%	01121	CB-2215	7-41235
R50	2.2 KΩ	COMP	1/4W 5%	01121	CB-2225	7-41247
R51	220Ω	COMP	1/4W 5%	01121	CB-2215	7-41235
R52, R53	6.8 KΩ	COMP	1/4W 5%	01121	CB-6825	7-41253
R54	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R55	33 KΩ	COMP	1/4W 5%	01121	CB-3335	7-41261
R56	2 KΩ	VAR TRIM WW		80294	275-1-202	7-54202

CIMRON

PARTS LIST

ASSEMBLY: DC Preamplifier — CIMRON PART NO. 68-6016

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
RESISTOR						
R57	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R58	39 KΩ	COMP	1/4W 5%	01121	CB-3935	7-41262
R59	33 KΩ	COMP	1/4W 5%	01121	CB-3335	7-41261
R60	82 KΩ	COMP	1/4W 5%	01121	CB-8235	7-41266
R61	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R62	270Ω	COMP	1/4W 5%	01121	CB-2715	7-41236
R63	22 KΩ	COMP	1/4W 5%	01121	CB-2235	7-41259
R64	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
R65, R66	39Ω	COMP	1/4W 5%	01121	CB-3905	7-41226
R67	1 KΩ	COMP	1/4W 5%	01121	CB-1025	7-41243
SEMICONDUCTOR						
CR1, CR2		*CD-61 DIODE		15318		7-95511
CR3		**CD-62 DIODE		15318		7-95507
CR4, CR5		*CD-61 DIODE		15318		7-95511
CR6		**CD-62 DIODE		15318		7-95507
CR7, CR8		ZENER DIODE		JEDEC	1N719	7-95610
CR9		ZENER DIODE		JEDEC	1N710A	7-95627

CIMRON

PARTS LIST

ASSEMBLY: DC Preamplifier — CIMRON PART NO. 68-6016

SCHEMATIC DESIGNATION	DESCRIPTION VALUE	TYPE	RATING	MANUFACTURER CODE	PART NO.	CIMRON PART NO.
SEMICONDUCTOR						
CR10		*CD-63 DIODE		15318		7-95503
CR11		*CD-61 DIODE		15318		7-95511
TRANSISTOR						
Q1		CT-26 or 2N2222		15318		9-04710
Q2, Q3				JEDEC	2N404	9-04607
Q4, Q5				JEDEC	2N3565	9-04725
Q6, Q7				JEDEC	2N526	9-04616
Q8, Q9		CT-26 or 2N2222		15318		9-04710
Q10				JEDEC	2N1305	9-04608
Q11				JEDEC	2N1304	9-04500
Q12				JEDEC	2N3565	9-04725
Q13				JEDEC	2N3638	9-04722
Q14				JEDEC	2N3565	9-04725
Q15				JEDEC	2N3638	9-04722
Q16				JEDEC	2N404A	9-04609
Q17				JEDEC	2N3567	9-04719

CIMRON

PARTS LIST

ASSEMBLY: DC Preamplifier — CIMRON PART NO. 68-6016

SCHEMATIC DESIGNATION	DESCRIPTION			MANUFACTURER		CIMRON PART NO.
	VALUE	TYPE	RATING	CODE	PART NO.	
TRANSISTOR						
Q18				JEDEC	2N404A	9-04609
MISCELLANEOUS						
DS1		LAMP GLOW		15318	NE-2H	5-46501
K1, K2		COIL REED ACTUATING		15318		80-0302-1
S1, S2		RELAY REED		95348	MR-306-8	7-38216
T1		TRANSFORMER		15318		68-0501-1
T2		TRANSFORMER DEMOD		00348	MT18FB	9-01001
G1		CHOPPER		08664	C1417-2	1-92001
		CHOPPER MOUNTING BRACKET		15318		70-2005
		4 PIN CHOPPER SOCKET		72825	9721-194	8-24110
		ETCHED CIRCUIT BOARD		15318		68-7016-1

NOTE:
PARTIAL REFERENCE DESIGNATIONS SHOWN.
FOR COMPLETE DESIGNATORS ADD 1600.
EXAMPLE: C1 is C1601

*CD-61, I_f = 1V greater than 100 ma, I_r = 75V less than 1 ua, SILICON

**CD-62, I_f = 1V greater than 100 ma, I_r = 300V less than 6 ua, SILICON

***CD-63, I_f = 1V greater than 15 ma, I_r = 30V less than 100 ua, GERMANIUM

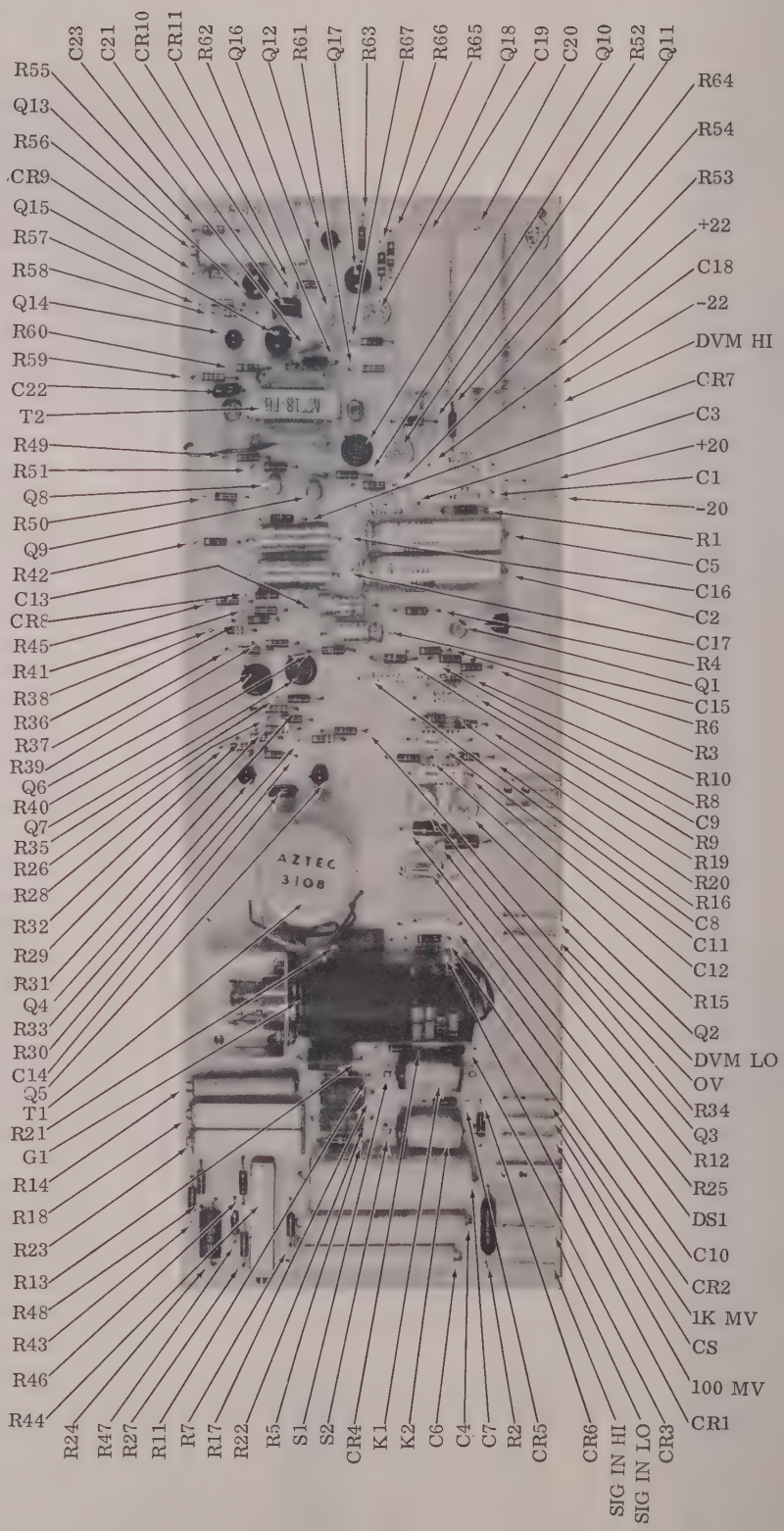
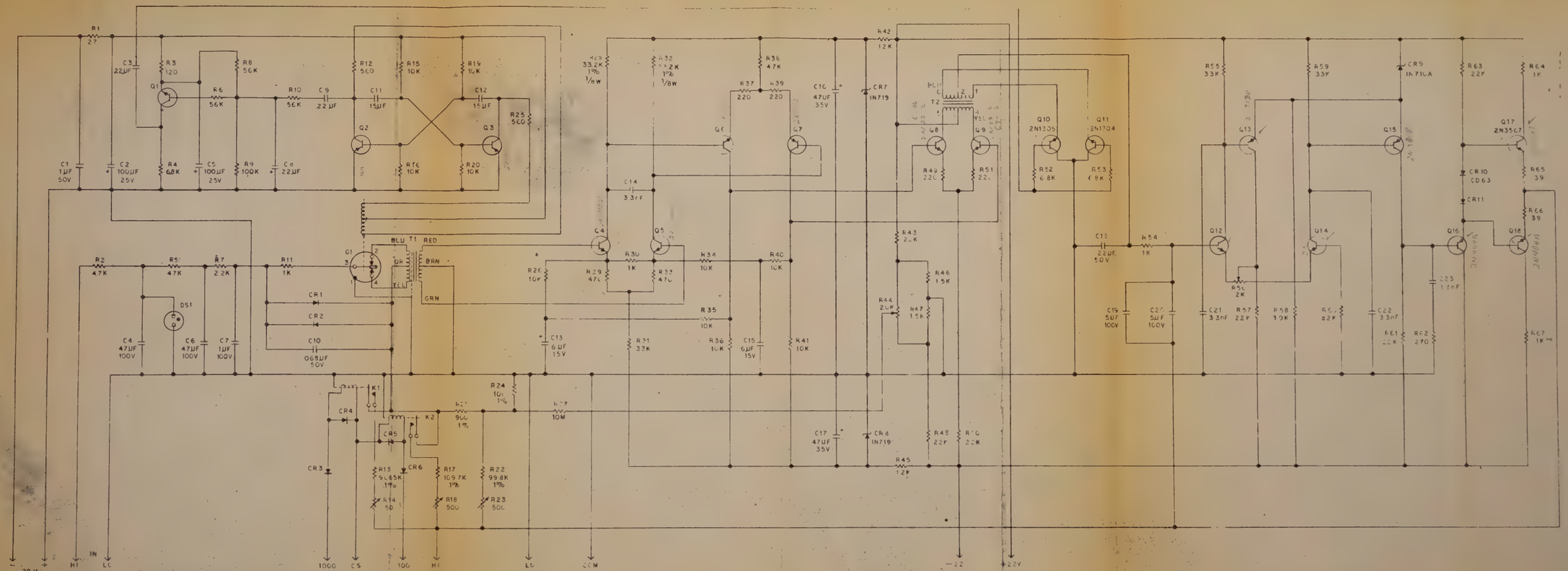


Figure 8B-4. Model 6880 DC Preamplifier Plug-In Accessory.



NOTES:

1) ALL RESISTORS ARE ±5% ¼W UNLESS NOTED OTHERWISE.
2) Q1, Q6, Q9 ARE CT26; Q2, Q3 ARE 2N404; Q16 Q18 ARE 2N404A
Q4, Q5, Q12 & Q14 ARE 2N3565; Q13 & Q15 ARE 2N3638; Q5 Q7 ARE 2N526.
3) CR1, CR2, CR3, CR5 & CR11 ARE CD61; CR3, CR6 ARE CD62.
4) LAST NO. USED: C23; CR11; DS1; J6; K2; R67; Q18; T2
NO'S NOT USED: NONE

5 PARTIAL REFERENCE DESIGNATIONS SHOWN
FOR COMPLETE DESIGNATOR ADD 1600
EXAMPLE R1 IS R1601

MODEL	6880
CHG NOS	
PROJECT	
DESIGN	
CHECK	
DRAFT	

68-0716
SIZE A
DRAWING SIZE R

SCHEMATIC
DC — PREAMPLIFIER

CIMRON

68-0716 REV A

APPENDIX

TABLE OF CONTENTS

Section	Page
ABBREVIATIONS	A-2
MANUFACTURERS	A-3
WARRANTY	

APPENDIX

WORD	ABBREVIATION
alternating current	AC
ampere	A
atto 10^{-18}	a
bel	B
capacitor	CAP
carbon	CAR
centi 10^{-2}	c
ceramic disc	DISC
common	COM
composition	COMP
connector	CONN
cycles per second (hertz)	c/s
deci 10^{-1}	d
degree Celsius	^{o}C
degree Fahrenheit	^{o}F
degree Kelvin	^{o}K
deka 10^{1}	da
demodulator	DEMOD
deposited	DEP
digital voltmeter	DVM
direct current	DC
double pole double throw	DPDT
electrolitic	ELECT
encapsulated	ENCAP
farad	F
fast-up	f-up
femto 10^{-15}	f
fixed	FXD
germanium	Ge
giga 10^{9}	G
gram	g
ground	gnd
guard	grd
hecto 10^{2}	h
henry	H
hertz	Hz
hour	h
impedance	Z
indicator	IND
Joint Electronic Device Engineering Council	JEDEC
kilo 10^{3}	k
maximum	MAX
mega 10^{6}	M
metallized	MET
meter	m
mho (siemens)	mho
micro 10^{-6}	u
milli 10^{-3}	m
miniature	MINI
minimum	MIN
minute	min
mylar	MY
nano 10^{-9}	n
neon	Ne
normally closed	NC
normally open	NO
note	*
ohm	Ω
paper	PAP
peak	P
peak to peak	PP
pico 10^{-12}	p
polarity	POL
polycarbonate	POLYCARB
polystyrene	POLY
position	POS
potentiometer	POT
pound	lb
receptacle	REC
resistor	RES
root-mean-square	rms
rotary	ROT
second	s
siemens	S
silicon	Si
silicon controlled switch	SCS
silver	sil
single pole double throw	SPDT
single pole single throw	SPST
spring	SPR
tantalum	TANT
tera 10^{12}	T
thermistor	THERM
trimmer	TRIM
value selected at factory	*
variable	VAR
volt	V
voltampere	VA
watt	W
with	w/
without	w/o
wire wound	WW

LIST OF MANUFACTURERS

CODE TO NAME

FEDERAL SUPPLY CODE	MANUFACTURER	ADDRESS
00194	Walsco Electronics Corp.	Los Angeles, California
00348	Microtran Co., Inc.	Valley Stream, New York
00656	Aerovox Corp.	New Bedford, Massachusetts
00853	Sangamo Electric Co.	Pickens, South Carolina
01121	Allen Bradley Co.	Milwaukee, Wisconsin
01281	T. R. W. Semiconductors, Inc.	Lawndale, California
01295	Texas Instruments, Inc.	Dallas, Texas
02111	Spectrol Electronics Corp.	San Gabriel, California
02567	International Electronics Industries, Inc.	Nashville, Tennessee
02572	Inland Electronics Corp.	Aurora, Illinois
02660	Amphenol-Borg Electronics Corp.	Chicago, Illinois
02768	Fastex Division of Illinois Tool Works	Des Plaines, Illinois
03614	Bussmann Mfg.	Los Angeles, California
03797	Eldema Corp.	Compton, California
03877	Transitron Electronic Corp.	Wakefield, Massachusetts
03911	Clairex Corp.	New York, New York
04062	Elmenco Products Co.	New York, New York
04217	Essex Wire Corp.	Los Angeles, California
04264	Circon Components Co.	Goleta, California
04387	Dale Electronics, Inc., Pacific Division	Burbank, California
04852	Mosley Electronics, Inc.	Bridgeton, Missouri
05276	Pomona Electronics Co., Inc.	Pomona, California
05347	Ultronix, Inc.	San Mateo, California
05593	Illumitronic Engineering Co.	Sunnyvale, California
05704	Alac, Inc.	Glendale, California

FEDERAL SUPPLY CODE	MANUFACTURER	ADDRESS
05791	Lyn-Tron, Inc.	North Hollywood, California
06090	Raychem Corp.	Redwood City, California
06743	Clevite Corp.	Cleveland, Ohio
06751	U. S. Semcor Division of Nuclear Corp of America	Phoenix, Arizona
07088	Kelvin Electric Co.	Van Nuys, California
07115	Corning Glass, Electronic Components	Bradford, Pennsylvania
07150	Electro-Mech Components, Inc.	Van Nuys, California
07344	Bircher Co., Inc.	Rochester, New York
07382	Rotor Clip Co.	Bronx, New York
07694	Triad Corp.	Encino, California
07716	International Resistance Co.	Burlington, Iowa
07910	Continental Device Corp.	Hawthorne, California
08065	Accurate Rubber and Plastics Co.	San Diego, California
08538	Chicago Dynamic Industries, Inc.	Chicago, Illinois
08664	Bristol Co.	Waterbury, Connecticut
08795	Rayclad Tubes, Inc.	Redwood City, California
09097	Electronic Enclosures, Inc.	Los Angeles, California
09145	Atohm Electronics	Sun Valley, California
09772	West Coast Lock Washer Co.	Downey, California
09985	Trolex Corp.	Elkhart, Indiana
10003	Grant Pulley and Hardware Co.	Los Angeles, California
11115	Tung-Sol Electric, Inc.	Bloomfield, New Jersey
11237	Chicago Telephone of California, Inc.	Pasadena, California
11769	Elco Pacific	Los Angeles, California
11837	Electro Scientific Industries, Inc.	Portland, Oregon
11897	Plastiglide Mfg. Corp.	Santa Monica, California
11903	M. E. C., Inc.	Nashville, Tennessee
12060	Diodes, Inc.	Chatsworth, California
12406	Elpac, Inc.	Fullerton, California
12498	Crystalonics, Inc.	Cambridge, Massachusetts
12617	Hamlin, Inc.	Lake Mills, Wisconsin
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13103	Thermolloy Co.	Dallas, Texas
13812	DialCo Electric Corp.	Brooklyn, New York
14099	Semtech Corp.	Newbury Park, California

FEDERAL SUPPLY CODE	MANUFACTURER	ADDRESS
14655	Cornell-Dubilier Electric Corp.	Newark, New Jersey
14752	Electro Cube, Inc.	South Pasadena, California
15318	Cimron Corp.	San Diego, California
15551	Kalpa Scientific Laboratories, Inc.	Flemington, New Jersey
15837	Motorola, Inc.	Arcade, New York
15849	UseCo, Inc.	Mount Vernon, New York
17109	Thermonetics, Inc.	Canoga Park, California
17227	Raytheon Co.	Mountain View, California
17452	Morgan Adhesives Co.	Stow, Ohio
17516	Moore, Maynard H. Jr., Inc.	Stoneham, Massachusetts
17826	Techno-Components Corp.	Northridge, California
17856	Siliconix, Inc.	Sunnyvale, California
18702	Ducommun Metals and Supply Co.	Los Angeles, California
18736	Voltronics Corp.	Hanover, New Jersey
21226	Executone, Inc.	New York, New York
24655	General Radio Co.	West Concord, Massachusetts
28480	Hewlett-Packard Co.	Palo Alto, California
28520	Heyman Mfg. Co.	Kenilworth, New Jersey
30874	International Business Machines Corp.	New York, New York
42190	Muter Co.	Chicago, Illinois
44655	Ohmite Mfg. Co.	Skokie, Illinois
46384	Penn Engineering and Mfg. Corp.	Doylestown, Pennsylvania
47904	Polaroid Corp.	Cambridge, Massachusetts
49671	Radio Corporation of America	New York, New York
53800	Sears Robuck and Co.	Chicago, Illinois
55026	Simpson Electric Co.	Chicago, Illinois
56289	Sprague Electric Co.	North Adams, Massachusetts
70331	Alpha Wire Corp.	New York, New York
70666	Automatic Products Co.	Detroit, Michigan
70903	Belden Mfg. Co.	Chicago, Illinois
71279	Cambridge Thermionic Corp.	Cambridge, Massachusetts
71468	I. T. T. Cannon Electric Co.	Los Angeles, California
71482	Clare, C. P. and Co.	Chicago, Illinois
71590	Centralab, Division of Globe Union, Inc.	Milwaukee, Wisconsin
71775	Cunningham, James, Son and Co.	Honeoye Falls, New York

FEDERAL SUPPLY CODE	MANUFACTURER	ADDRESS
71785	Cinch Mfg. Co.	Chicago, Illinois
72005	Driver, Wilber B., Co.	Newark, New Jersey
72314	Fairchild Camera and Instrument Corp.	Syosset, L. I., New York
72825	Eby, Hugh H., Inc.	Philadelphia, Pennsylvania
73680	Garlock, Inc.	Palmyra, New York
73899	J. F. D. Electronics Corp.	Brooklyn, New York
74970	Johnson, E. F. and Co.	Waseca, Minnesota
75237	Kayner Mfg. Co.	Pico-Riveria, California
75594	Liberty Hardware Mfg. Corp.	New York, New York
75915	Littelfuse, Inc.	Des Plaines, Iowa
76005	Lord Mfg. Co.	Erie, Pennsylvania
76530	Monadnock Mills	San Leandro, California
76545	Mueller Electric Co.	Cleveland, Ohio
78277	Sigma Instruments, Inc.	South Braintree, Massachusetts
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78929	United States Plywood Corp.	New York, New York
79094	Victory Engineering Mfg. Co.	Millvale, Pennsylvania
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pennsylvania
79963	Zierick Mfg. Corp.	New Rochelle, New York
80095	Burgess Battery Co., Battery Division	Chicago, Illinois
80112	G. C. Electronics Mfg. Co.	Los Angeles, California
80223	United Transformer Co.	New York, New York
80294	Bourns Laboratories, Inc.	Riverside, California
80368	Sylvania Electric Products, Inc.	New York, New York
80640	Stevens Arnold Co., Inc.	Boston, Massachusetts
81073	Grayhill, Inc.	La Grange, Illinois
81541	Airpax Products Co.	Cambridge, Maryland
82042	Carter Precision Electric Co.	Skokie, Illinois
83330	Smith, Herman H., Inc.	Brooklyn, New York
84171	Arco Electronics, Inc.	Great Neck, New York
86270	Bendix Corp.	Baltimore, Maryland
90002	Hubbel, Harvey, Inc.	New York, New York
90201	Mallory, P. R. and Co., Inc.	Detroit, Michigan
91833	Keystone Electronics Corp.	New York, New York
92379	Burroughs Corp.	Chicago, Illinois

FEDERAL SUPPLY CODE	MANUFACTURER	ADDRESS
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, New York
94222	South Chester Corp.	Chester, Pennsylvania
95264	Lynn Electronics Research Co.	Burbank, California
95348	Gordos Corp.	Bloomfield, New Jersey
95354	Methode Mfg. Co.	Chicago, Illinois
95566	Arnold Engineering Co.	Marengo, Illinois
97564	Pendar, Inc.	Coeur D Alene, Idaho
98291	Sealectro Corp.	Mamaroneck, New York
98978	International Electronics Research Corp.	Burbank, California

7630 S/N 5912

IMPORTANT

Include the instrument model number and the serial number in any correspondence regarding this instrument. The above serial number must match the instrument serial number if parts are to be ordered from the manual. Your help in this will enable us to answer your inquiries and fill your order with the least possible delay.

WARRANTY

All CIMRON instruments are fully warranted to be free from defects in material and workmanship for a period of one year as per CIMRON's standard terms and conditions of sale. This warranty does not, however, cover tubes, transistors, choppers, fuses and/or batteries. Mechanical stepping switches are guaranteed for ninety days provided they have been lubricated in accordance with manufacturers instructions.

Should replacement parts be required, whether at no charge under warranty or at established net prices, notify us promptly, including sufficient details to identify the required parts. We will ship them (shipping charges collect) as soon as possible, usually within twenty-four hours.

In the event factory service or assistance is required for this instrument:

1. Give CIMRON's Customer Service Department prompt notice in writing of the nature of any suspected defects.

2. Upon receipt of written authorization and shipping instructions from CIMRON, return the instrument (TRANSPORTATION CHARGES PREPAID) to CIMRON's main plant located at 1152 Morena Boulevard, San Diego, California 92110.

3. CIMRON will acknowledge receipt of the instrument and indicate warranty status. No charge will be made for repairs covered by terms of this warranty.

4. In the event repairs are "out of warranty", CIMRON will provide the customer with a quotation which will require the customer's approval before the work can be accomplished. Return of the instrument to the customer shall be with TRANSPORTATION CHARGES COLLECT.

CIMRON reserves the right to adjust the prices and make design modifications without notice.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it does not operate or is damaged, a claim should be filed with the carrier. A copy of the claim should be sent to CIMRON. Upon receipt of the claim we will advise you of the disposition to be made of the instrument and arrangements will be made for repair or replacement. Do not return an instrument to CIMRON without prior approval.

The above statements and warranty constitute a part of our Standard Terms and Conditions of Sale as published in our order acknowledgement which is CIMRON's Warranty in its entirety.

CIMRON DIVISION

LEAR SIEGLER, INC. / LSi

ELECTRONICS FOR MEASUREMENT - CONTROL - AUTOMATION